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E S S A Y S
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A G R I C U L T U R E :
O R, A

Variety of useful Hints, for its Improvement,
WITH RESPECT TO

AIR, WATER, EARTH, HEAT and COLD;

As an Attempt to ascertain their Influence on Vegetation.

TOGETHER WITH REFLECTIONS ON
ANIMALS, PLANTS, SEEDS, SLIPS and MANURES.

To all which is prefixed,

An ADDRESS to the LITERARY SOCIETIES in EUROPE,
established for the Improvement of Natural Knowledge.

By M. Beardé de l'ABBAYE.

TRANSLATED FROM THE FRENCH.

Quis est enim, qui totam diem jaculans, non aliquando collineet?

CICERO.

L O N D O N :

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C O R R I G E N D A.

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(11)

T H E

P R E F A C E.

ENQUIRIES, which have for their object the good of mankind, should doubtless interest mankind in their favour, even before they have attained the end proposed: It is true, success is the only thing, which sways the acknowledgments and suffrages of mankind: but, society ought to pay a no less regard to the cares, the pains, and labours of those who have their welfare at heart. The general regard of the public is never the most pressing motive, which animates a philosopher, solely intent upon doing all the good in his power; the satisfaction he finds in his labours, and above all, the hopes of success, are to him the most flattering reward; and such is the spirit which has presided over this work; exceedingly happy shall I be, if the thoughts, which run through it, should give birth to new and useful, or at least agreeable projects; and become the occasion of some new discoveries; my good intention is all the merit I wish to be allowed; I freely give up all claim to the glory, which may result from the discoveries I wish to see made, to those whom my reflections may put upon making trials; and I heartily wish them success. I only bring together a variety of scattered and neglected materials, in the hopes, that some abler hand shall vouchsafe to make use of them.

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In proportion as Europe improves in civility, as the taste for knowledge encreases, and philosophy spreads, we see assemblies of learned men starting up, and forming themselves in different parts. These illustrious bodies widely diffuse their light; the arts acquire a new consistence; ignorance, prejudice, and a blind practice are ceased, and give way to the more certain principles of an enlightened theory: at length every thing is tending to perfection; and such is the end of these respectable societies, the establishment of which will immortalize their founders, while the glory of being a member of them, consecrates the names of learned men, whose talents and merits might otherwise remain unknown. But, are views so honourable, so salutary, so useful to society, at all times fully answered? It is to academies I address myself; I have no thoughts of reading lectures to our masters; I mean only to propose my ideas to academicians, who have the happiness of mankind at heart; unable to restrain the bitterest reproaches against those, who are no longer influenced by so laudable a motive. It is in the name of humanity, of which I am a portion, in the name of society, and the public, of which I am a member, that I here loudly complain of the behaviour of many learned men; who, after taking every possible step to get themselves honoured with the title of academician, have from the moment of their reception, ceased to render themselves worthy of it; have indolently laid themselves down, not on laurels, but on that earth, which only wanted their attention, to yield a rich harvest of them; and, with so much the more reason I complain, as they thereby not only break through the conditions, to which their new state obliges them, but moreover uselessly occupy a place, which others would fill to much better purpose; I complain, that being chosen by proper judges, they cannot but possess the accomplishments necessary for their province, and for enriching cotemporaries, and posterity with some new discoveries; and thus it can only be
want

want of good-will, that they deprive society of those services, it has a right to expect from their researches. Infine, I complain of that selfishness, which is only taken up with its own little interests, to the neglect of the general good. This indolence is unhappily become epidemical; several literary societies give, but at very distant periods, a few slight productions; and these, only due to two or three worthy members, who have some regard left for the interests of humanity.

Complaints, equally well founded might be extended to some certain entire bodies, who are in a languishing state, and emit but a very feeble glimmering light, instead of that luminous blaze, which the public has a right to require from their rank and their talents. Besides the indolent inactivity which is peculiar to them, they are moreover chargeable with the inutility of the labours of a great number of learned men, who are no members of their society: what I mean is, that having prizes to distribute, academies have in their hands that portion of glory, to which every man of letters makes it a point to aspire: the questions they propose, become thus fixed subjects, which determine or fix the speculations of a number of men of letters, or of genius; whence it follows, that when these questions have but an object futile, narrow, and uninteresting, all the observations, made in consequence, are of very small value. Not to mention the vanity of a thousand metaphysical researches, and the uncertainty of systems, built, with so much labour, on a distant and obscure antiquity; or those hypotheses, which can admit of no other proof but random conjectures; not to exclaim against those pretended discoveries, which a fruitful imagination invents, and which may give occasion to some useful novelty; I declaim in the name of the public, against that hodge-podge of erudition, which our modern authors are so fond of displaying in their works; nor, must I omit those propositions, which are so limited, as often to take in a single

little district, to the excluding the rest of the world, either from the researches they require, or from the advantages which might result from them. Such are, for instance, "What are the productions, which suit best with the territories of the republic of Saint Marino, or Ragusa?" Such is the stile, in which some of these questions are proposed. And thus, a few paltry acres of ground shall alone reap the benefit of the most excellent memoirs.

But, what influence can the warmest and most pathetic declamation of a friend of men have? The literary world is a republic, in which every individual has, indeed, a right to remonstrate against abuses, without the power to reform. Good citizens will in vain raise their voice on this occasion; academies will ever enjoy that republican liberty, and nod on, if they please, in their culpable lethargy. After all, I dare to say, that this is a real injustice, and that the rights of the society are betrayed, and the intentions of the founders no longer complied with; the profession of academician is no longer in hands, that comply with the duties of it, or make those returns, which the public has a right to expect; nay, those establishments, the dispensers of honour, and often of interest, recompence members, who never once fulfil their engagements. What! shall so irreparable an injustice disgrace an enlightened age? To overlook an obligation, and neglect the duties, in which the society is interested, is it not to fail in an essential point? Before what tribunal ought they to reclaim their rights? But we have too long lamented over faults so striking; let us leave it to time, to the zeal of ministers, who watch over the public welfare; they have a right to demand an account of those revenues of glory and interest, the capital of which was entrusted to the hands of academies: a Sulli, a Colbert, would, no doubt, as well as the public, ask, what regard they pay to the intentions of the founders. But till the authority of a superior power shall redress grievances, in which the state

is interested, let us propose an expedient, which cannot bear hard upon that dear liberty, claimed as the portion of men of letters. They have, as I have already said, formed little confederacies, under the name of literary societies; these different academies, as they are called, are spread all over Europe; though all are in a manner guided by the same views, they have notwithstanding no mutual dependence. Now, what should hinder these little republics from forming a general confederacy, and establishing an amphictyonic council, or states general; such a council, composed of deputies or representatives from all the other bodies, might receive literary complaints, and act the part of a parent. But I shall not now enter farther into this matter. If, however, this scheme meets with approbation, it cannot be from those lethargic societies, whose slumber, inaction, and abuses want reformation.

Could example and emulation have any salutary effects on minds sunk in sloth, I might here quote the many illustrious works of so many learned societies, who are daily improving our knowledge and enriching their age with so many valuable discoveries: such are those of London, Paris, Berlin, Petersburg, and several others too well known to require any particular mention; the public is too well acquainted with its benefactors.

In the republic of letters, the same law which gives every individual a right to complain, lays him likewise under an obligation to furnish his contingent for the good of society; and it is this duty, this good, which I could wish to procure for my fellow-creatures, that animates and warms my zeal. In short, the desire of being useful, is the only motive for this work. I pretend not to the glory of invention or novelty; I give it up, I again repeat it, chearfully to those, who shall reduce to practice any of those ideas or hints which I now barely propose. I affirm nothing; nor do I pass any decision;

decision ; I barely present, under different points of view, a variety of projects, which may give rise to some happy discoveries.

Technical terms prove an obstacle to science, we are obliged to study words, before we can learn things. What reproaches are due to those learned men, who, to appear still more so, wrap up their discoveries in a language the least intelligible? proposing their physical ideas under the veil of the most intricate algebraic symbols, as if wanting to withdraw themselves from the view of mankind. For my part, I cannot help looking upon natural philosophy as the science of the most common things; and, of course, that its doctrines cannot be rendered too clear, nor brought down too low, to suit every capacity. But these inaccessible literati are much more taken up with their own glory, than with the welfare of the public.

I shall give myself very little trouble about the choice and order of my thoughts; and still less about the elegance of my expressions: on the contrary, I shall endeavour to use the most common and popular terms, in order to be understood the better: I shall be well pleased, if the husbandman understands me, it is chiefly for him I write. In short, I shall have attained my end, if I may prove the means of some happy success. It is only with the view to induce others to make trials, that I have here thrown together such a variety of ideas, which I look upon as new; or at least most of them being new to me, may be so to several others; I therefore beg of all well-disposed persons to consider my design, only as a collection of trials, which I invite the reader to make, with a view to pleasure or profit: that is to say, they are but so many conjectures, thrown out like seed at random for the general good, which may in good hands produce excellent fruit; or, at least, give rise to other new projects in the minds of other persons.

I am well aware, that the ruling taste is to have decisive processes, and infallible methods; in a word, what they call secrets; whereas

I only

I only offer hints, some of which may possibly be never effected; I offer but conjectures; and if it happens, that I quote some observations, I declare before hand, that it is done merely, in order the better to unfold my thoughts; I never offer them as decisions, as precepts, or as rules to be followed.

I only offer hints, some of which may possibly be never effected; I offer but conjectures; and it is happening, that I quote some observations, I declare before hand, that it is done merely, in order the better to unfold my thoughts; I never offer them as decisions, as precepts, or as rules to be followed.

My first object is to show, that the human mind is not a tabula rasa, but that it is furnished with ideas, and that these ideas are the foundation of all our knowledge. I then proceed to show, that the mind is not a passive receiver of impressions, but that it is an active being, which forms its own ideas, and which is capable of reasoning. I then show, that the mind is not a mere collection of ideas, but that it is a system, in which the ideas are connected together, and which forms a whole. I then show, that the mind is not a mere collection of ideas, but that it is a system, in which the ideas are connected together, and which forms a whole.

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ESSAYS

IN

AGRICULTURE, &c.

CHAP. I.

1. **T**HE discovery of any specific remedy for the least of our complaints, or of new ways to satisfy our wants, and sooth our afflictions; the invention of any little instrument or tool more handy and more expeditious for use; are a thousand times of more intrinsic value than the most learned observations of the ablest astronomers, who, having espied some little star, a pretended comet, near some constellation, spend whole nights in studying its course,

B its

its orbit, its aphelion, its ascension, its node; and at length takes occasion, from this celestial appearance, to give an ample description of the zodiac. The doctrines of monads, of atoms, of substantial forms, that number of metaphysical systems and scholastic treatises, with which the memories of our European youths are encumbered, that number of useless subtleties which are learned with such difficulty, do all of them, taken together, not yield as much service to mankind, as a husbandman, who has found out the secret to secure his fields against insects, or made some other the like discovery. The generality of the learned apply themselves more particularly to objects of pomp and show, prefer generally the splendid and brilliant, which gains them a name, to common researches, which would only gain them a degree of merit. The works speak, the productions depose in favour of all those whom I have not in my eye, in these my incessant declamations. The object, which all the literary societies have in view, being already settled and determined, it would be as ridiculous as useless to propose any other whatever: but the means being of an arbitrary and undetermined nature, I imagine it laudable for each one on his part to concur, and shape out his own way; and as we may arrive at the useful by so many different routes, whoever should discover one more sure, more commodious, more easy, or more short, would merit well of society. It is thus that, through briars and thorns, I go in quest of some unknown by-paths, which may lead me to the public good.

2. Agriculture, become so fashionable, in an age, in which its utility is so evidently acknowledged, a general eagerness prevails every where to write on the culture of lands. Fancy has brought forth in the closets or private studies of writers a number of systems; and but a very few exact observers have added practice to theory; and generally the result of so many researches are but speculations often fanciful, sometimes impracticable, and almost always useless; all

all owing to the want of trials or experiments; either too few have been made, or they have been ill conducted. Let us run over the works which come forth from every quarter; they are almost only bare repetitions, their end being agriculture in the large way, they have confined themselves to general principles, and from two or three particular experiments, have always deduced general consequences. This, however, is not the greatest evil, nature being ever uniform, conclusions drawn from the little to the great, and on the contrary, every thing else being equal, must always be just; it is only to the fault accompanying experiments I mean to object; or, in other words, to the justness of their application.

3. Of all those, who vouchsafe themselves the trouble of making a variety of trials, there are very few, capable of comprehending the real causes, to which the result of their operations is to be attributed. Every man has his own peculiar notions in physical, as well as in all other matters; and hence it necessarily follows, that every man, in consequence of the principles he adopts, attributes the effects he observes to the causes he thinks the most likely to produce them. Thus, an ignorant person shall ascribe a very great vegetative virtue to bare sand, and look upon it as an exceeding good manure, because he has seen it produce on a hard, clayey, glutinous soil, a plentiful crop.

4. But let such ignorance pass; for, though it must be of the utmost importance to be well acquainted with the principles which preside over our operations, yet the main point is to proceed in them, were even the real cause unknown. Let us, for instance, rest satisfied with knowing, that the jesuits bark is a specific in most fevers, without knowing precisely how it acts. Experiments well vouched on the advantages of this or the other method, on the virtues of this or that fossil, must ever be deemed discoveries of the utmost value, notwithstanding our continuing utterly in the dark

with regard to the true origin of such virtues and advantages. Facts are what we particularly want; if we cry out on the ignorance of those who make observations, it is not so much against the defect of their knowledge that we ought to be on our guard, as against the justness of their operations. Some deceive, and some are deceived. The former, jealous of a pretended discovery, sacrifice truth, in order to support with obstinacy the good effects of a remedy of their own discovery, or some practice of their own invention, far preferable, in their conceit, to any other that was ever devised. The fondness for his offspring blinds the eyes of every parent: we, therefore, cannot be too much upon our guard against that enthusiasm, with which all authors of pretended discoveries are universally tainted.

5. We are, no doubt, greatly indebted to those, who lay themselves out in making researches; and, though they have not always succeeded, if they happen to impose upon us with regard to the marvellous effects of the methods they have devised, we however ought to hold the pains they have taken, in some account, and more especially the new ideas they may have started. A book, they say, is never so bad, but it may contain some good things. The inutility of those who deceive themselves, is owing to their making their experiments badly, and describing them still worse. Their intentions are doubtless very laudable, but we can learn nothing from them.

6. Persons the most skilled in physics, and with the best intentions for the welfare of society, give themselves a thousand useless pains; when their knowledge is confined to speculation, every thing in the practice disconcerts them, every thing there is new to them; they are unacquainted with the proportions, the usages, and those minutiae of detail, which habit alone can give; they harass themselves for mere nothings; and, the most ignorant peasant will sow
his

his field or his garden much better than they can. We are to expect but very little assistance from those, who otherwise are the most capable of making researches into nature, had they, in their turn, as much docility for the labours of the field, as they require of the husbandman, for the direction of his labours, they would diffuse a new light all over agriculture, and would become the luminaries of that profession. Though naturalists have not carried their patience so far as to submit to the drudgeries of the field, they however fail not daily to improve its operations.

7. Great wits, or men of genius, are the most dangerous persons: the charms which they know how to strew in their works, that soothing eloquence which pleases and persuades, often serves to the perpetuating errors. Seduced by plausibility of language, the readers imagine themselves instructed, when only amused with chimerical systems: this is particularly the case with some authors; who though they never saw a plough, set up, notwithstanding, for professors of agriculture. Such deserve the severest reproaches: accustomed to write, they boldly treat on subjects, which they only know by hear-say. The extravagant fallies of their imagination cannot but mislead all those who have the misfortune to read them. Though it would be the highest injustice to require of all authors that they should know how to handle the spade and shovel, before they set up to prescribe laws for others; they ought at least to follow the practice of being first taught themselves, before they teach others. But to shew the necessity of previous experience, and the benefit to be expected from it, let us see what those can effect, who disdain not to put their hands to the work.

8. The arts, which hitherto have made the greatest discoveries, are, without all manner of doubt, such as the learned have been most in the practice of: such as chemistry, which has made surprizing progress; owing alone to the care of those, who have blown

up

up the coals of their furnace with their own hands. But, to confine myself to agriculture, the branch brought to greatest perfection, is most assuredly the culture of flowers. They are become a new creation: we can scarce distinguish in the hand of the florists their hyacinths and ranunculuses, &c. compared with the same flowers as produced by nature. A fancier, lying stretched on a border, espies the progress of vegetation, assists, accelerates it, and augments its force in a superior degree. A plant, which naturally grows with five or six leaves, shall thus be forced to yield many hundreds. The size, the colour, the smell, every quality is in perfection; nature is embellished, and becomes undistinguishable under the watering-pot of the florist. A parterre, therefore, ought to read a lesson to agriculture: if the employment about flowers, a matter of mere amusement and curiosity, has thus the advantage over so many useful arts; and, if husbandry derives not equal advantages from the labours of so many philosophers, who write on the subject, it is merely because, either they make no experiments themselves, or do not repeat those made already, make them too much in the great, or, in fine, do not closely follow them.

9. Let us propose means, such as those suggested by Linnæus. This famous observer, the ornament and glory of Swedeland, is for having every naturalist apply himself to a single plant, a single animal, &c. and this he does on occasion of a treatise written by M. Duchesne, in which that able botanist gives us an account of his method of cultivating strawberries, and the success attending it. He has found means to encrease their size, vary their flavour, and, in fine, to multiply the species. It is thus we become creators. It is, in paying this gentleman the tribute of praise he so well deserves, that Linnæus expresses his wishes, that the lovers of agriculture would, each, dedicate their researches to some single production; it is thus, that the florists have the advantage over all other cultivators;

cultivators; next come the gardeners, who, though they have greatly outdone the husbandman, are far from outdoing the florists; whom I propose as models to whoever, like them, want to improve, invent, perfect, and, in short, create.

10. From a cursory view of the interesting detail of the different relations there are between the several kinds of assistance required by nature, we shall find that she never fails to repay, with the utmost generosity, all the pains we can take to facilitate her operations. This is an enquiry which deserves our most serious attention; and it is merely in consequence of our not conducting it in every point of view, that agriculture, and perhaps, all the other arts, continue so long in a state of infancy and imperfection, from which the light of natural philosophy, in the hands of practical philosophers, should rescue them. Without pretending particularly to enumerate all these relations, I shall just point out a few of them, and leave every reader at liberty to add such ideas and hints, as may occur to him on the subject.

C H A P. II.

Of the Air, with regard to Agriculture.

11. **S**INCE the modern discoveries made in natural philosophy, especially since the experiments of Torricelli's air-pump, this element has been considered both as a medium, and as an agent, whose influence extends to almost every part of our globe. It should seem that after ascribing to it most of the operations of nature, we should
have

have a more especial eye to its efficacy in agriculture, where it acts a very considerable part.

12. The air may be considered as either at rest, or in motion, hot or cold, elastic or non-elastic, heavy or light, &c. But, when we view its influence on the productions of the earth, it is more particularly with respect to its degree of heat or cold. This is what we generally understand by climate. Such a plant, we say, cannot grow or ripen in such a climate, because too hot or too cold. This application, being so general, causes many mistakes, as we are so apt to ascribe every thing to the presence or absence of heat; we ought however to believe, that there are an hundred other causes, which either aid or which retard vegetation, and which should be investigated with care. I will be bold to say, that the theory of the air is still in its infancy; yet it is perhaps the principle of all the effects of nature, and so far, possibly nature herself. I make no doubt, that did not the system of Spinoza clash with revelation, philosophers might possibly come to account for every thing that happens in the three kingdoms of nature, by his *anima mundi*, or soul of the world.

13. When we measure the distance of the sun, or if you will, the degree under which a country is situated, we are surprised to find, that the productions of the soil are not relatively proportional to this division; I mean, that different countries, under the same latitude, do not produce the same plants. The different histories, experience, and, above all, the relations of travellers strongly confirm this truth. Nor is this all; in the same kingdom, the vine, for instance, shall thrive better in a district more to the north, while in another, more to the south, all other things being equal, it will not ripen at all. This is what may be easily verified in all the Champagne countries, where the exposure is nearly every where equal. If this extraordinary difference is not to be ascribed to the
heat

heat of the air, it can as little be imputed to its agitation. The winds are continually shifting, whilst the productions are constantly the same. Philosophers ascribe these changes to the heterogeneous particles, with which the air is impregnated. A greater quantity of nitre, or of the vapours, discharged from some neighbouring mines, are according to them the causes of these variations.

14. But, why recur to bodies foreign to the air, whilst itself is so little known. Its parts escape our senses, its figure; its properties are still unknown, though not out of the reach of our observations. Not to expatiate at present on a subject, which requires a work apart, I shall only say, that air is improperly considered as a fluid; it is not so much as a liquid, except in those latitudes, in which the sun has strength sufficient to keep it in fusion. I shall go farther, and call it a solid body, whose parts being extremely subtile, have a very great degree of hardness, though of a sufficient length; and that their length, as well as their rigidity, is apt to vary in proportion to the quantity or rapidity of the fire acting upon them. They are like so many bundles of wire, whose particles or fibres are sometimes fused, and greatly softened, and sometimes very hard and penetrating. By their extraordinary fineness, they are qualified to enter the pores of all bodies, without producing any ravage in them, as long as there is heat enough to keep them in that state of softness or suppleness peculiar to bodies in fusion; but, on the absence of fire, they recover their force in proportion to the degree of cold; it is then they rend, tear to pieces, and burst asunder the most compact substances. What I have been just saying stands independent of the freezing of water, which nearly produces the same ravages as the air, of which it is only the consequence.

15. I shall venture to say, that a mass of air, such as it is in the inhabited climates, contains a great number of other bodies, as long as it is moveable and penetrable; I mean as long as it con-

tinues in fusion, these bodies float about in a confused manner in and with it; but they have, almost all, a determinate direction; they form, as it were, so many different torrents, independent of the perpetual ebbings and flowings of the air: such are light, the subtile matter, the æther, the electrical fire, the magnetical torrent; so many species of phlogistics or fire, Vanhelmont's gas; the acidum pingue of the ancients; the archæus; and, perhaps, an infinite number of other fluids, to which no discreet philosopher will venture to assign bounds; and the matter of sound, as distinct from the air, in which it floats, as is the light, which is equally propagated in it. The principles of attraction and gravitation; the spiritus rector of vegetables; the general soul of the world; continue still to be so many enigmas to the most strenuous sticklers for Descartes or for Newton.

16. I shall say, that the plants, which thrive so well at the foot of a mountain, can never ripen at its top, though, there undoubtedly, nearer the sun; and that, on the other hand, the snow lasts longer there, though more exposed to its heat.

17. I shall farther say, that it is, perhaps, a mistake to imagine the weight of the air to be the cause of the rise of the mercury in the barometer; since, in that case, we must admit a new mass of air, of a prodigious extent, or ascribe the cause of so enormous a pressure to some unknown body, the weight of which will make about the ninth part of our atmosphere; this immense quantity of air must be supposed to come from some other quarter, whence it would follow, 1st, that the air, by becoming heavier in one place, must become lighter in some other, since the whole of the atmosphere must constantly continue the same; 2d, that this surprising pressure must act upon seas and lakes; and that with much better reason than that which the moon is pretended to exert; and the more so, as this planet has no sensible influence upon the barometer;

meter; 3d, that, in consequence of such extraordinary pressure, we should feel an uneasiness as often as the weather happens to be fine, since it is then that the air is pretended to press most. And such is the change, which, in effect, we all experience, on the top of a mountain, or in the bottom of a plain. This change, however, though so very sensible, is far from being occasioned by the ninth part of the atmosphere, and yet this is what the barometer indicates. And this variation often succeeds from one day to another, nay, in the very same day, without our perceiving it: on the contrary, in fine weather, the air appears lightest, &c. Not chusing to proceed farther in these observations, I shall content myself with considering the air in points of view, which, though little thought of, are far from being imaginary, I mean with regard to agriculture.

18. As the smallest portion of air contains a quantity of fluids, which float or circulate in it, may we not fairly suppose, that several of them may have an influence on vegetation. The magnetical torrent, for instance, having always its determinate course, either at the bottom of the waters, or under the earth, or even in the middle of the air, and that the most agitated, even in a contrary direction; this torrent, I say, every where diffused, freely pervading the inmost parts of bodies, and acting so violently on iron and the load-stone, must, it is plain, act likewise upon such plants, as have their pores of a magnetical configuration. Now, as we are utterly unacquainted with the configuration of these pores, and yet know, for certain, that, in the animal and mineral kingdoms, there are particles subject to the attraction of the load-stone, we may venture to conclude, that there may likewise be some in vegetables; and, in that case, it is easy to guess what impression these plants may receive from the magnetical particles.

19. The electrical matter, equally diffused with the magnetical, may, in its turn, be constantly producing, even under our very eyes,

effects, of which we do not so much as suspect the cause. We may say the same thing of all those other fluids, which, like the light, make their way into every corner, and with most of whose operations we are utterly unacquainted.

20. But, to return to the husbandman, and speak only of known observations, I may say, that plants, which grow in the open air, are continually and without intermission deriving some nourishment from it. Nay, air may possibly contain a vegetative virtue, a collection of germs, or souls, endued with a power of fecundation, independently of heat, humidity, nitre, and all the other known principles of vegetation. For example, the earth or soil of a cellar, produces no plant, not for want of moisture; no place is damper; or of heat, none more constantly as well as more temperately warm; nor yet for want of manure, seeing the earth or soil of cellars contains a great deal of nitre, often visible in them, and which always produces the best effects in open air; nor, in fine, on account of any malignant quality, capable of stifling, or even retarding vegetation, since all the plants brought into such places live, grow, and come to perfection there. We must actually strew some seeds there, a thing no ways necessary in the open air, in which every kind of earth or soil, even that taken from cellars, never fails to produce grass without any visible seed. The air, therefore, contains invisible germs.

21. We are acquainted with a vast number of plants, which may be produced, and made to grow without the assistance of earth; such, for instance, are the bulbous and several other plants. But, I mean not here to speak of those which are raised in, and nourished by water. I confine myself wholly to such as live on air only. Onions will shoot of themselves, without earth and without water; parsnips, but above all radishes, will produce leaves in abundance, and even stout stems, with no other nourishment, but that afforded
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by the air; and these productions are found to exceed, in weight, the tubercles from which they originally sprang.

22. There are other plants, which, being come to a certain growth, continue their vegetation, though cut or plucked out of the earth. Most of the porous trees shoot branches and leaves, though separated from the trunk; and this, without being entirely indebted for it to the small quantity of sap, of which I shall speak hereafter. The only circumstance, we are here to consider, is the additional weight, which these plants, or their parts, acquire independently of the sap. The plant, called Capucine by the French, the Indian cresses, being pulled when grown, will keep for several months, becomes gradually dry at bottom, but, at top, encreases in size, spreads, produces flowers and fruit. A trellis, or lattice, adorned with these flowers, cut or pulled near the earth, might be set in our windows, and for months together, give us to enjoy their prospect, their coolness, their shade, without any earth or water to subsist them; and there are, perhaps, several other vegetables, which we might apply to the same agreeable purpose.

23. It is merely with a view of exciting mankind to avail themselves more of the air, that I cite these well-known effects. Even the stars may have some influence upon vegetables, analogous to that, which the magnetical matter has on iron and the load-stone. It is by going deep into observations of this kind, that we may expect to make useful discoveries. On observing the barrenness of some lands, which, to the eye, and the judgement, appear capable of vegetation; on examining the infinite variety in the productions of the same kind in different countries, we are constrained to acknowledge the cause of that difference to be in the air alone. So many considerations, independent of heat, wind, exposure, the quality of the soil, and other known causes, should be sufficient to convince us of the necessity there is to analyze the air. Would philosophers vouchsafe to
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do it, we might attain to the knowledge of the first principles, which stifle or retard certain productions in one country, which they cherish and accelerate in another, under the same degree.

C H A P. III.

Of Water.

24. **I** Have nothing to add to the excellent treatise on water, and its uses in agriculture, after what M. Bertrand, a zealous member of the useful society of Berne, has favoured the public with. As to his theory, I have elsewhere said, that it is the principle of vegetation and fruitfulness.* All we have farther to do, is to take a view of it under other aspects.

25. Water is found to ascend of itself, in all tubes not exceeding the thickness of a hair in bore. It insinuates into them, rises into them, without any external pressure, that we can discover, to force it up, or any internal attraction to solicit it. All we know, and all we see, of the matter is, that it tends upwards, of itself, contrary to the general laws of equilibrium, which, on other occasions, it so exactly and constantly observes. This is what philosophers call the ascent of liquids in capillary tubes. The causes of this phenomenon,

* See a new System of Manures, London 1763.

menon, debated so long in the schools, have not been yet demonstrated; and the systems, hitherto devised by learned and ingenious men to account for it, are, by no means, satisfactory. This principle, however, being once well understood, we might thence derive such consequences and informations, as could not fail of having their use in the œconomy of the three kingdoms; and, even, in most of the operations of nature. We see water ascend in all those bodies, whose pores are about an hair's breadth in diameter, as in sugar, cloth, sponge, &c. and, this tendency to ascend is doubtless that which forms the basis of all vegetation. Water, or, if you will, the sap, insinuates into the fibres of the roots, it spreads, it rises in all the capillary tubes of the plant; which is nothing else, either in its stem, or in its branches, but a collection or bundle of those capillary tubes. The cause of this tendency of liquids in such tubes, must therefore be deemed an object of the last importance, since, by its means, we might explain the growth of vegetables, their diseases, their death, and contrive to forward them, to relieve them, nay, perhaps, bring them to life again.

26. Nothing merits more the researches of the philosopher. This discovery stands connected with that of air. Its theory, once well ascertained, would lead us to the cause of the minute or slow movement of liquids. Perhaps, it is to be ascribed to the configuration of the fibres of the air; I mean, that, these tubes, containing but a small portion of a weak, tender, subtile air, whose ramifications are besides less resisting than those of the circumambient air, the surface of the liquids is readily introduced into them: or, perhaps, it may be the reverse. But, this discussion would carry us too far. Those, whose mighty minds can comprehend the full play or extent of action of the Newtonian attraction, must, I am certain, devise some shorter method. In a word, whatever may be the reason that obliges nature to deviate here from the
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common laws of the gravity of bodies, we must consider it as the most important enigma the learned still have to resolve. I must, therefore, persist in inviting them to set about it, as the solution could not fail of laying open to us the progress of nature in every other body. And what happy applications might not be made of such a discovery?

27. Another point of view, in which water may be considered, is that, in which it serves for nourishment and growth to plants; water alone makes several of them shoot, grow, and ripen. Might we not avail ourselves of this nutritive virtue? We have so much land under water, so many fens, such collections of useless waters, of which some use might possibly be made. We are certain that there are several bulbous plants, which thrive to admiration in water. It would be pleasant enough to see whole fields floating on a surface of water by means of bulbs: provided each had a guide, a small stay to direct the germ and root to their natural position, we might form borders of hyacinths in the heart of a pond. I mean that we might dispose a slight trellis or lattice of osiers in rings, in squares, in hearts, or other compartments of agreeable figures; dispose in each small square of this lattice the bulbs of as many different kinds of flowers as we please, and then launch the whole upon a basin or body of water; we should soon have a parterre, ambulatory, or fixed, enamelled with a thousand charming flowers: this variety would doubtless prove infinitely more pleasing to the eye, than the cold and melancholy prospect of a sheet of water, ever gloomy, and ever uniform.

28. The marshes, springs, rivers, lakes, seas, contain vast quantities of plants; some at bottom, others at top, while others again float and grow in the air, though their roots reach through the whole depth of the water. We take too little notice of such plants; the husbandman neglects them; the botanist and the physician scarce
vouchsafe

vouchsafe to cast an eye on them. And yet, what advantages might we not derive from so much useless water, by multiplying and combining their productions, and coming thus to have floating meadows.

29. This idea should not be confined to plants alone, considering the many trees and shrubs to which water alone can give subsistence, and whose stem only we wanted to lengthen. It is thus, that by planting at bottoms of water long branches of fallows, alder, poplar, &c. we should soon see, with pleasure and profit, a forest arise, where before we had only water.

30. We are likewise to observe, that water being much less susceptible than air of changes of heat and cold, it has almost always the same degree of temperature, down to the freezing point exclusively. It is this, that makes certain animals seek, in water, an asylum against the winter's cold, in a climate, where, in the open air, they could not withstand it: it is for this reason, that fishes may be transported from a warm to a cold climate, and from a colder to a warmer, and that without suffering much inconvenience by the change. It is for the same reason, that all exotics, whether plants or trees, natives of the water, might without prejudice be transplanted into a strange climate, however opposite in temperature.

31. For instance, in the West-India islands there is a tree, called Manguel, which is highly valuable, on account of a variety of uses. Its wood is so hard, but growing harder still in water, as, in some measure, to be petrified. Piles made of it know no decay; the bark is good for tanning: as it has several very valuable properties, care should be had to transport it to Europe. It grows in salt water; and thus it is probable that it would thrive on our sea coasts. It would be a thing both very agreeable and very useful, to plant forests of it along our shores, where the depth of water is not very considerable: for, besides the real produce of these trees, they

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might serve for a rampart, and secure the coast against hostile debarkations. If planted close together, the smallest bark could not reach land without much difficulty: and even supposing an enemy should undertake to cut them down, in order to make himself a passage, they could be cut no lower than to the surface of the water, and then the stumps alone would still be sufficient to keep him off. A fortification of this kind would have many advantages over those now in use which cannon demolish. And, as this production of the water requires nothing but a barren sand and the moisture of sea-water to come to perfection, it appears very probable, that it would take to admiration in our climate. How many forests might we not then boast of in places, where nothing now is to be seen but sand and water.

32. Two ingrateful and barren soils, often produce, when mixed, plentiful crops; probably the mixing of waters might have a good effect in agriculture. The sea-water is what we ought, in particular, to study most. Its extent, its immense quantity should excite all our attention. For instance, supposing we came by different trials to discover some new properties in salt waters, it is evident to what useful purposes it might be turned. In short, if by some preparation it was made a manure of, what a source of riches, what magazines would be opened to the industrious husbandman!

33. Dew is productive of such good effects, that, in like manner, we should endeavour to dive into its origin; as, by that means, we might perhaps contrive to accelerate or retard its fall occasionally, and even preserve it for a much longer time; but if by any process, we could succeed to encrease its quantity, we should then have in our hands, so to speak, the keys of the earth's fecundity.

34. Rain is all in all in vegetation; but, as man's power does not extend to produce the smallest drop of rain, or of dew, we should make our essential business the indications which may foretell rain.

rain. The study of the seasons, especially that of the changes of weather, is or ought to be the basis of a wise and prudent agriculture. A field sown three days later, yields a crop three times more considerable than an adjoining field of equal goodness, but which has been rained upon only some days after. Oftentimes the space of four and twenty hours suffices to dry up by the sun's heat, or by something else, a spot fresh sown. On these occasions, the winds act a very considerable part, as they do in every thing that surrounds us. Husbandmen should therefore be invited to act as mariners do, who, when they can neither raise, nor lay the winds, should, at least, study to foresee them, and make the proper use of them when they blow.

35. We are acquainted with some part of the good effects of snow, and yet it is neglected. Besides the quantity of nitre it brings with it, it conserves the most tender productions from cold and frost. Nay, there are several plants, which grow, and even blow amidst snow. Why not endeavour to multiply them. Why not form a meadow, and even a parterre amidst hoar-frosts? and yet nothing is easier: if we collect those plants, we shall deck a surface of snow with leaves and flowers. In short, why not amass snow to screen, during the winter, the tender plants?

36. Water has so great an influence in the effects of nature, as would alone require several volumes. Some want to know hidden springs, their copiousness, their depth, and their qualities; others want to drain overflown grounds. Sometimes, we have too much, and sometimes too little water; and notwithstanding all those occasions, we are not yet arrived at any certain rules. When a particular extent of district is under water, we relinquish it, and the waters stagnating, prove as pernicious, by mustiness or other corruption they contract, as they are useful, when they water our lands in a constant stream. Mechanics should here be made to simplify

our hydraulic machines, as by means of them, we might perhaps, when worked by wind, procure a kind of flow and ebb in these low and overflowed bottoms, where no drain could be made: that is to say, raise the water by windmills to such a height, as would be sufficient to carry it off to a distance; and supposing that it was impossible to discharge it, and that it should return to the place it came from, yet its motion alone would suffice to render it useful.

37. We might, likewise, correct the bad qualities of waters, as soon as we could analytically ascertain their principle of corruption. Perhaps, some cart-loads of sand or lime, across which the waters of a bad quality might be made to drain, would fit them for fertilizing different soils, the vegetation of which was heretofore retarded. But, it is not always by straining water, that we are to clear it of those foreign particles, which constitute its malignity: we may devise different mixtures, fetched from great depths, and, in short, the re-union of different springs.

38. Vapours and fogs are as little in our power as dew and rain; but, might we not prevent or retard their bad effects? might we not, by making great fires, or great smokes, lessen them, or drive them away to some distance; or, at least, secure the neighbourhood from their ill effects? if it is true, that, in some countries, they keep off the clouds, and, of course, rain and hail, by the noise of cannon, or rather by the rarefaction of the air, caused by the explosion; the same might possibly be much more effectual on fogs, as standing much nearer to us.

C H A P. IV.

Of Heat and Cold.

39. **I**T is not always the presence of the sun alone that causes heat. The days of intense cold, which we sometimes feel in the height of summer, should be ascribed to the disposition of the air; the north winds are as little the sole causes of it. On this research the speculation of philosophers should be employed, in order to form the theory of the air, so necessary and so little known.

40. I have always thought, that the alternate succession of heat and cold was of use, and perhaps necessary to the growth of vegetables.* And thus, one constant and equal degree of heat in stoves and hot-houses is of less service, than when remitted from time to time: such, at least, is the march or process of nature.

41. To keep trees from frost, it is customary, in some countries, to kindle fires at proper distances, on the approach of night, when we apprehend the severity of the frost: this practice, which has been found so useful, is neither sufficiently known, nor propagated so much as it deserves. But how do such fires act at considerable distances? probably not by their heat, insensible as it must be at a distance, twenty, nay, a hundred times less. Perhaps, it is by their smoke alone, which diffusing itself among the young branches, covers or penetrates the pores on the surface of the tender shoots, the leaves, the flowers, or the fruits; these pores, thus filled, or taken up by the smoke, acquire a force, a sufficient resistance not to be hurt by the frost. This practice cannot be too much enquired into,

* See the new System of Manures.

into, as the success attending it preserves, as by a charm, orchards, amidst many others, in which not a single flower is left.

42. As the planetary aspect augments or diminishes considerably the degree of heat, we should always endeavour, according to the new tillage to raise the borders towards the North; which might likewise be done, in small, by giving the furrows this elevation. We observe every winter's day, when snow and hoar-frost overspread the fields, that one side of a furrow is almost all bare, while the other is covered with them.

43. There are several ways of restoring frost-bitten fruit to their pristine state; such as burying them in snow; and might we not, in like manner, recover our tender buds and shoots when hurt by the frost? Yet it is no uncommon thing to abandon and give up for lost, trees, and even whole vineyards, that have suffered by a frost, being considered as irretrievably lost; why not attempt some means for their recovery? as certain vapours, exhalations, snow, or water.

CHAP. V.

Of Earth.

44. **T**HREE fourths of our farmers consider this element as the foster-mother of plants; and yet, she is but the medium or placenta. A shrub, planted in a pot or box, shall grow to weigh one hundred pounds or upwards, and yet the earth about it shall scarce lose any thing of its weight.

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45. It is true, that, as the earth contains several heterogeneous particles, these concur to vegetation. The business is, in order to procure fecundity, to supply the earth with plenty of those nutritive particles, and then to dispose the soil, in such a manner, as that it shall not present any invincible obstacles to the tender fibres of young roots, which want to extend and lengthen themselves, in proportion as they swell and grow; which nature never fails to do, in proportion to the size and wants of the plant. Hence it follows, that, the mixing of earths should always be made according to the tenacity or looseness of the particles, which compose them.

46. Seeing, therefore, sand, gravel, and even small stones, may cause an abundant fruitfulness on a field, the soil of which is too close, compact, and as it were gluey; it should seem that every thing should be subjected to the researches and occasions which agriculture requires. I mean, that perhaps, there is nothing, without its use, in the whole extent of nature. The driest soils, the most naked rocks, abandoned and neglected, contain almost always hidden treasures, though not all of them fit for the plough: mines of all sorts, quarries of marble and agate, or beds of precious stones, &c. nay, the barrenness of a spot is even an indication of its containing mineral particles, unfavourable to vegetation. Search, dig, and analyse, and you will not fail to make some useful discoveries. Fossils of every kind are numerous, from which very great advantages may be procured. The different beds of earth, which you will meet with, have their virtues, which will always repay your labour, if you are a proper judge. We must learn to distinguish a mine of calamine from a common quarry; a layer of fuller's earth from a bed of marl. This great number of Fossils should be made a study deep, extensive, minutely explained, and brought down to the level of every capacity. And yet, of all the branches of Natural history, this is the most neglected, though, doubtless, a thousand

and times of more consequence than futile collections of shells, butterflies, &c.

47. There are instances of useless spots of ground being converted into salt-petre plantations. Might we not, in like manner, form plantations of other fossils? such a mine, for instance, exhausted and abandoned by our fathers, has fructified again, and yields, at this day, a new metal. Should we not endeavour to transplant those germs or seeds of metals or minerals into uncultivated fields, after ascertaining the soil proper for them? small pebbles of calamine, thrown into pits, and covered up, yield in a few years a new and plentiful production. Stones, in like manner, have their growth. It is very true, that metals and gems, take more time to ripen and attain perfection, than vegetables. But being assured that this growth is real, why might we not transplant masses of earth or of stone, pregnant with the seeds or embryos of metals and precious stones?

48. Sands are, perhaps, the most useless soils; on these we should make the most trials. What advantage might not society reap, if ever a philosophical farmer came to gather any productions from those immense tracts of sand abandoned by the sea and by rivers? so many unprofitable downs, and such extent of useless shores, are yet fit for some kinds of plants. Probably the tribe of porous trees might thrive there, by laying their stems sufficiently deep, to furnish their roots with moisture. How many trials of this kind might not be made with very little trouble and expence?

49. If ever I have leisure and opportunity, to put in practice what I am so earnest in inculcating on others, for the good of mankind; I mean, if I can one day devote myself entirely to some one plant, study and rear it, ascertain its properties and virtues, there is one which I shall take into particular consideration; and that is the CAMENERION. It springs on the hardest gravel, in the driest sand,
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on rocks, on walls; in short, in places where no other plant can live; and yet, it grows to the height of a foot, and sometimes a foot and a half; produces a pretty large quantity of seeds, in very long and slender pods. On gathering a sufficient quantity of these seeds, and sowing them in their proper season, we may perhaps be able to turn naked sands into useful fields. I imagine that this plant is not used for any medicinal purposes; but, our not knowing its virtues is no proof of its having none. Here then, is a new subject of attention to our academies. How many enquiries remain still to be made? how many valuable qualities lie hidden in plants, which grow neglected under our feet, of which we have not the least suspicion? But, to return to the CAMENERION, I must invite those, who have an opportunity of procuring its seed, to collect as much as they can, to sow them in different seasons, at different depths, and in different soils; were it only to procure litter for cattle, that alone would be a great matter in countries where forage is scarce.

50. Different soils have so many different qualities, as alone to require a very large treatise. The subject is in a manner inexhaustible. A society of observers, who devoted themselves to this object alone, might favour the public with many useful discoveries. The analysis of the different soils, with regard to husbandry, is perhaps, the least difficult task: the more simple, mild, and free from taste and smell is an earth; or, at least, the more homogeneous its parts, the more easily may it be fitted to become a seed-plat for vegetable germs.

51. But, the infinite number of different uses, to which different soils may be applied, ought to be taken into great consideration. Pharmacy, chemistry, painting, and numberless manufactures, stand in need of particular kinds of earth, &c. which may all be constituted a branch of trade. It is highly probable, that many private persons have lands teeming with riches of which they know nothing.

New discoveries are every day making in this respect; some earth is proper for making porcelain, which at this day enriches the owners, while their progenitors complained of owning a soil so unfit for agriculture. And how many treasures, still unknown, to us, may not be discovered and made a proper use of by our descendants?

52. I must observe, by the bye, that as so many fabrics, or manufactures of tile, pottery, porcelain, glass, &c. require a degree of fire more or less intense, the principal expence of these manufactures consists in the consumption of pit-coal, wood, peat, turf, char-coal, or other combustible matters. Now, as we are on all sides surrounded with fire, and since every body contains a certain portion of it; might we not turn to some account this phlogistic, so universally diffused? At least it is certain, that the rays of the sun collected, exceed the most violent heat of our furnaces. Burning glasses, but especially burning mirrors, melt, calcine, vitrify the hardest bodies, and that in a much greater degree than our ordinary fires. This operation so simple, and so easy requires neither wood, nor coals; so that, as long as the sun shines, so long might we, by means of concave mirrors, or convex glasses keep up the most intense heat, without any expence. The saving, which might be made by this process, as well as its superiority above all others, should, induce the curious to bring it into use. It is the business of genius to contrive hearths, and other proper devices, which might with advantage replace our furnaces. It is true, that on the absence of the sun, these operations are suspended; but that defect is fully compensated by the rapidity and vehemence of this fire. Besides, this inconvenience is common to most of our machines, which are worked, some by wind, and others by water; for though these agents are as little in our power, as the sun, we scruple not to employ them, and that to good purpose.

C H A P. VI.

Of Plants.

53. **I**N most countries, farmers content themselves with the common and usual plants; while often at a few leagues distance, others of considerable advantage are cultivated. We are not to confine our enquiries in this respect, to our own neighbourhood only; all countries produce a great variety of flowers, fruits, seeds, trees, and other vegetables, which are peculiar to them; and those of the most remote climates might, perhaps, with a little care, be made to thrive perfectly well. Our gardeners, it must be owned, employ this method with good success. Farmers should use the same method. There are so many exotic plants, which by the care of our gardeners are brought to the same perfection as in their native climate; nay, many of them are at this day considered as indigenous.

54. If agriculture is in this respect at a stand, it is because our farmers will never think it worth their while to allot their care to a single plant, like the gardeners and florists. A farmer wants to sow a whole field at once; and if the first essay fails, he is discouraged, and but rarely makes a second trial. And yet, it is only by giving a particular and minute attention to a particular plant, that we can expect to bring it to perfection, and to encrease either its quality or quantity. For the truth of this operation, we need only appeal to the methods used with flowers and fruits, and with all the plants cultivated in green-houses, in comparison with the attention be-

stowed on field-plants ; and then compare the quality and quantity of the fruits.

55. Among the infinite number of plants, with which we might enrich Europe, I ought to mention the MANIOC ; a plant very easy to raise ; and its family-uses are so great as to surpass, perhaps, all our vegetables. In the West Indies, they use the meal of this tree or shrub to feed their blacks with ; and, as this plant is less liable than any other to suffer by the weather, nothing is better adapted to prevent scarcity of grain. The following is the way of cultivating it. The whole of the plant, which grows pretty much like the elder-tree, has knots two or three inches asunder ; the wood they cut into pieces which have two knots each ; and planted in a hole made with a pick-axe only, it is sure to take root. They lay it obliquely, and close the earth upon it to secure it ; other preparation it requires not. This cutting or slip, which at first was only half a foot long, and an inch or two thick, grows in a year, to the height of ten or twelve feet, and serves to form a new plantation. The root grows considerably, some times a foot thick ; and resembles almost a carrot of tobacco. This root is the part of the plant they use. They grate it on a large grater, with a vessel underneath to receive the water that runs from it ; this water is a poison ; the meal, they put into bags, where they leave it to dry or drain ; they, then, pass it through a sieve ; and, next, they spread it on iron or copper plates, under which they keep a fire, till the meal is sufficiently baked ; it is in this state that it is preserved : they give it to their blacks, as it is, or soaked in water. A full goblet of it is sufficient for the most hungry. But mixed with water, it is more than can be used at a meal. This small quantity is so substantial, as to support and nourish the blacks, who being obliged to toil from morning to night at the hardest work imaginable, require the most nourishing food. The water which we said was a poison, is at first
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white as milk; after standing, the water is drained off; and on the sediment they pour spring or rain water; this washing is repeated, till the sediment becomes extremely white; no starch or powder being whiter. They likewise make the most delicate biscuits of it. After all, though this wood be very spongy, it does not require a moist soil; all it wants, is to be kept a little cool in the beginning. Considering how well the pine-apple has succeeded in our European stoves, it is probable, the manioc would thrive equally well in the open air of our southern climates, and perhaps, elsewhere, since the most essential part of it is that which grows in the earth. It bears seed, of which no use is made any more than of that of their sugar canes, or of that of our vines; the grape-stones we neglect, and depend entirely on the slips and cuttings, which are found to answer much better. Perhaps, however, on sowing some of the seeds of the manioc, we might accustom it gradually to our climate; and, I repeat it, that we have nothing in the European agriculture to come up with it in usefulness; so that I cannot, too much invite our naturalists to make observations and trials upon it.

56. They have likewise, in the West Indies, a kind of Aloes, called lapitre: its leaves are three or four feet long, two or three inches thick, and about six broad. These leaves contain threads, or rather a silk, which is very fine and surprisingly strong; and, accordingly, they make very good cordage. It is with these delicate threads they make the whips, with which they correct their slaves; and they cut at every stroke. How many useful purposes might not this curious substance answer, could we have it in plenty of our own growth?

57. There are so many other very valuable vegetables in America, that I should never have done, were I to particularise all their properties. I shall mention only one instance, more singular than useful; it is that large tree, called Genipa: it bears a white apple, of a surprising whiteness on the inside. The water, which is squeezed from it affords

fords amusement to the planters, by washing some one with it; the effect does not directly appear, only in four and twenty hours after, when the person is changed to a Negro of a very beautiful black. It is in vain to wash, no soap is of service for it, the person continues a negro for nine days; the blackness never wears off sooner; which it does probably by insensible perspiration. Naturalists may, perhaps, draw several new and useful conclusions from this phenomenon.

58. What I have been saying of America, is to be understood of all the other parts of our globe, especially of Asia, which yields a profusion of valuable vegetables, of which we have not so much as a description. Among others, there is in the Malay Islands a tree; which, in point of usefulness approaches the manioc. They call it SAGOU, or the SAGOWFEROUS PALM TREE. The Indians dilute the meal it contains, much in the same manner that the negroes do their manioc meal. Some of our modern journalists tell us that this substance is now to be had at Paris.

59. I must not here forget to exhibit the immense sums, of which Europe is every year drained to pay for the mere leaves of a tree, which would thrive very well amongst ourselves. There is something astonishing in the calculations made on this subject. The gold of Europe is constantly running off to Canton, merely to purchase that plant. And this all the while, that societies of agriculture are daily starting up on every side, numbers of learned men devoting themselves to the cultivation of plants; our colonists and florists every where at a great expence collecting herbs, which, I may venture to say, are of little value; infine, all the while that nothing is to be heard in every corner of Europe, but researches and trials relating to husbandry; this same Europe is constantly expending every year her fairest gold for the produce of a foreign tree; and what is more surprising, this very tree would thrive perfectly well in any one of their fields: at least we may fairly conclude this, since the celebrated Linnæus has contrived

contrived to keep in conservation one of them in Sweden, the coldest country almost in Europe. To what zealous observer, to what patriotic society, are we, then, to be indebted for the cultivation of the Tea tree? If they cannot succeed in rearing it, let them at least look out for some other leaf, which may replace its daily use among so many nations, who cannot do without it. This appears so essential an object, to claim as much the serious attention of every wise minister, as of every able cultivator.

60. Since, there is then no country without its own peculiar vegetables, which none but professed botanists ever think of, why do they not apply themselves, to the detail of this immense department? If every botanist undertook to be useful to his country in particular, and to mankind in general; though he only discovered one unknown, or neglected plant; were the learned societies to offer premiums for the discovery of a specific; or of the virtues of a neglected plant, or in fine its unknown properties, either for relieving our wants, easing or curing our diseases, or improving or perfecting our arts, even those of mere pleasure, our age, so much enlightened already, would enrich posterity. I cease not repeating it; it is to detail, that we shall be indebted for happy discoveries. What study soever we view, it is to those who choose particular branches for their province, that we ought to give the preference. It is with reason, that we prefer a dentist, an oculist, an aurist in their particular study to the ablest surgeon, who takes in all the branches.

61. No one, I believe, will question that all the productions of wise and provident nature have essential virtues and qualities; most of which are still entirely unknown; or rather, the little we know of them, merits no account. And yet we still treat on the virtues of plants; and we already use several of them, concerning whose effects, we have some slight notions, supported by a few experiments; but, as several simples are considered as specifics in certain countries in
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some cases, whilst the inhabitants of other countries are terribly afflicted with the same disorders, without ever suspecting that they are continually treading under foot the very remedy for them: why not endeavour to make a collection of these scattered secrets? such a collection must needs be very valuable. Unhappily we have to expect almost all from chance: and perhaps for ten centuries together we could not by groping in the dark discover in some small shrub, a treasure, that savages have been long acquainted with. And thus, without decrying our naturalists, druggists, and chemists; I am apt to think that the method of analysis must be very uncertain, in order to hit upon the virtues of any unknown plant; and no better way there is, than to avail ourselves of the discoveries already made. An academy, which should devote itself entirely to this object, would render infinitely more service to society, than those, who by methodical calculations, and systematic combinations, have nothing more than a learned theory for their object.

62. I also rate according to their just value, those physical researches, which from time to time produce useful applications; especially when confined to some particular object. It is thus, Mr. Storck employs, for the cure of our disorders, those very plants, which, till he appeared, were deemed good for nothing but to do us harm. If, poisons become medicines, in able hands, who will dare to set bounds to the enquiries of the zealous friends of humanity? Go on to try, to make experiments on every thing; all nature lies open to your trials. Success attends not every attempt; should but a single one succeed, this would sufficiently repay all the pains taken; after all, it is only to persons, who wish well to mankind, I address myself; the hopes of becoming useful to their fellow-creatures, make them indefatigable: from those, who want perseverance, we are not to expect any important discoveries.

63. I now recollect a plant, which grows either in Provence or Languedoc, of a most extraordinary nature. The shepherds of the country, in a gross manner make purses or garters of it, such as might be made of the stalks of flax. These little tissues, when thrown into the fire, come out of it as whole, as if made of plume alum. I mention it only, because I imagine, that so extraordinary a plant is unknown almost to Botanists; at least, I have not yet met with any one, who could tell its name, and procure me the seed; though there are very few plants, so valuable for a virtuoso. To how many entertaining and useful purposes might it not be applied? After all, I suspect, that what I have been assured as the effect of a plant, may be that of the *Amiantus*, called the incombustible flax; a bundle of very fine threads, of the length of two inches at most, found on a mountain in the neighbourhood of Baneg, in the bowels of some steep rocks, from which it is no easy matter to extract it. They spin the threads of it, and make incombustible cloth of them. This fossil is a species of talck, different from the plume alum, of which they make the same use. Mr. Bertrand considers it as a kind of *Asbestos*.

64. Plants may be considered in different points of view; each of which may constitute a separate branch. From so many different branches of study, what success have we not to expect? For instance, we may consider some plants as perennial, those that withstand the winter's cold; others, annual; I purpose to speak of those, whose stem withers and disappears; but whose roots strike out anew in spring: there are of them, that irretrievably perish, after the latter feeding: It is this species of annuals, which I offer to the observations of naturalists.

65. Nature, perhaps, has originally bestowed on each plant the property of living and perpetuating itself, without the assistance of new seed; I mean, every plant may have been originally endued

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with

with the faculty of shooting forth, every spring, a new stem equally perfect with the old one. This holding of the greatest number of them, should incline us to think, that this might have been the general law of nature. And yet our grain, our corn, which are the most necessary plants for the support of life, die away after their course of production, and each year are to be sown anew, as they would otherwise absolutely perish. Had wheat, for instance, been liable to this annual destruction, without a natural re-production, it would follow, that if from the beginning of the world, men had not surmised, that this plant would shoot no more; and had they not preserved its seed, this valuable production would not have outlived the first year of the creation; and we should never after have heard of it. This notion is not quite so chimerical, as at first blush it may appear. In the first place we see that flowers, for instance, so embellished by the hands of the florists, and increased ten, nay a hundred-fold, in leaves or petals, have lost in quality, what they gained in quantity; since become double, they cease to yield seed. Yet it would be wrong to conclude, they never had any. I say the same thing of our several kinds of corn, which have gone so often through our hands, that we could have altered their primitive natural disposition. Secondly, We meet at this day with those very plants, which die with us every year, to the root inclusively, and which in other parts spring up again, like the hay of our meadows, without sowing them anew. This happens precisely in those countries in which agriculture has been most neglected, and nature alone has carried on the process, without being interrupted by the officiousness of man. Mr. Horrebow, a celebrated naturalist, having been sent to examine the productions of Iceland, found there among many other things, wheat, which is incessantly re-produced, like the grass of our meadows; its grain is something smaller than our wheat; but its flavour, of which the natives

natives are very fond, is delicious. Again, the flax of Siberia is possessed of the same re-productive quality; they cut it down every year, without sowing or previous culture. These plants, placed there by the hand of nature, have undergone no revolution.

66. We should, therefore, dive into and study the reason, for which our corn is not re-produced from its root. In this, as in all we have said, the business is, to succeed in a single plant, cultivated in a pot or box. Perhaps, by procuring the seed from Iceland, we might come to have fields of perennial corn: and possibly the care and attention of some able naturalist might contribute to restore to our corn this its primitive virtue. It is well known, that corn cut down, before the ear is well formed, shoots again, and produces a new stalk and a new ear. And thus perhaps, by retarding its maturation, or cutting it from time to time, or checking its vegetation, or by dexterously suspending its coming to perfection, &c. we might at length, come to see a new stalk put forth the next year, from a root, which we had kept from spending itself. In this case, the study of the circulation of the sap should enlighten our researches. If the root has received from above juices sufficiently elaborated, it ripens; and perhaps, dies because it can no longer admit any new juices; that is, the configuration of the fibres or pores of the root being altered by the elaborated sap, fresh and new juices can no longer be pumped and introduced into those disfigured canals. It is doubtless to the ripening and drying up of these conduits or pipes we may attribute the death of the plant. But, be that as it will, should some virtuoso by some industry or address, come to conserve the root of wheat, for instance; that faculty of reproducing itself, after ripening or maturity, though only in a single plant, would very soon suffice to enrich all Europe by so valuable a discovery. We are told, that, formerly it was usual with the farmers at the foot of the Alps to run the plough over the fields, after the corn was

shot up, and the plant began to form joints; many of those reversed stalks, were torn and lost; but there sprang so much from those that remained, as by this operation to yield a very plentiful crop.

67. I shall not here debate the political question on the employment of hands; I shall only say, that the provinces whose power gives umbrage to their sovereigns, are highly unhappy; that the number of hands in a country is a treasure, which the minister may be said to bury, when he does not make all possible use of them; that the price of labour is a circulation, which should always have its free course, and when retarded or clogged, the body politic sickens; in fine, if there was a country, so unhappy, as that the government should not seek to abridge the painful labours of the inhabitants, every other nation would in general be considerable gainers. Not to mention the support of humanity, the interests of commerce, manufactures, arts, or in a word, all those advantages united, arise in plenty, when hands are gained, without encreasing consumption.

68. Let us, therefore, suppose, that a virtuoso has some plants of wheat, barley, or other grain in pots; that he rears them with care; that he repeats his trials, on the seed, the soil and the season of sowing; that he waters them with the juice of different manures; that he cuts them; and that in fine employed only, like the florists on a single plant, he succeeds to render perennial a plant of rye, peas, or Indian corn, what satisfaction would it be, could he encrease the size, the number of stalks, the quantity of ears, and the goodness of the grain; could he only render the seed stronger, and stouter, and that by this means the grain of wheat, for instance, should withstand the smut, the rust, and other disorders; in fine, whatever discovery he might make, it would, doubtless, equal the pleasure of having doubled the flower of the Euphrasia, the little Centaury, or the Orchis, and having procured to these simples a distinguished rank in our parterres.

69. The

69. The disorders of plants are of two great consequences not to require exact observers. We have not as yet discovered sufficient remedies for prevention, nor specifics for cure. This study is more extensive than at first it appears. There was a person, who assumed the title of Tree-doctor. He insisted to have the patients brought home to him: and it is said, that he often restored them to health and life, a sick fig, or orange tree, must be pulled up by the root; he inspected their parts with care and then treated them, by bathing, or by amputation; and he prescribed a proper diet. But, all this apparatus of seeming quackery, failed not to have often a good effect.

70. Among the endemial, and perhaps epidemic disorders of plants, several owe their origin to different insects, some of which naturalists have already discovered, under the name of gall-insects, &c. and doubtless good microscopes would discover a great many more. One thing is sure, and very surprising, that there are vast numbers of insects, which are never found, but on certain particular plants. This mutual analogy between plant and insect is extremely curious. We sow for instance, the seed of a plant of very distant countries; and though at a hundred, or perhaps a thousand leagues from the place of its nativity; yet we shall soon find on the stem, the leaves, or the flowers, the little insect that is peculiar to it, though unknown all over the neighbourhood. Several caterpillars go by no other distinguishing name, but that of the plants, on which they are exclusively found. To compare these mutual relations, we should be better acquainted with the different principles of sensitive and vegetative life; and without applying here the system of Spinoza, it might perhaps, suffice to dive into the primitive cause of the substantial forms of the peripatetians; as, for instance, that of the configuration of the salts of plants, whose crystals constantly affect a particular figure.

71. But

71. But to return to matters of practice; what is it that is meant by the death of plants? Could we proceed but a sufficient length into this question, art might soon, possibly, succeed to bring them to life again; I only mean a great many of those, which we usually give over. The disarrangement of the fibres, the solution of continuity in the vessels, obstructions; infine, the desiccation of the parts; this is nearly, the sum of all our knowledge. It is by studying this mechanism in large trees, we should come to be instructed in the physical detail of plants. Let us endeavour to compare ideas. We imagine, we know what is the life of plants. A gentle moisture, an insensible, or a moderate degree of heat, keep up the motion of the sap; their growth, their vigour, their freshness assure us, that they live, and announce their health. We also know that any degree of excess kills them: too much moisture, too much drought, frost, excessive heat prove their ruin. In fine, the disarrangement of their essential parts, is generally the cause of their death; which, in consequence of this our knowledge, should be nothing else but the interruption of the vegetative functions; the first and principal is, doubtless, the circulation, or if you will, the course of the sap; for some will have it, that the juice duely elaborated, rises, and reaches the extremities of the plants, never to flow back again; whilst others pretend, that it circulates; what may be depended upon is, that the moment this course or motion ceases, the plant dies. Might we not, by the study of nature, find out remedies in this case? Gardeners know how to cure fractures, cuts and other the like accidents; which deprive the parts crushed, the branches broken, the bark torn, of that juice, which can no longer reach to them. All I mean by this multiplicity of words, is to make our agronomes or virtuosi in agriculture, sensible, that by the anatomy of plants and the analysis of their juices, we might hope to give some principles for a vegetable surgery.

72. The

72. The cure of sick plants would also require a peculiar system of physic for their internal disorders; by means of which we might possibly prevent the withering of the fibres; or remedy it, when happening. It is of their death I would speak, considered as either the cause or the effect of this their withering. For instance, these withered fibres might have preserved their suppleness, had they been smeared with, or well soaked in certain unctuous, resinous, balmy, &c. particles; hence it is, that all the trees, which contain any of these resinous substances, retain their verdure amidst the severest frosts. We find in the frozen countries of the North, some of those resinous trees, which, for ages together, have bid defiance to the bitterest colds. Might not art employ some such similar helps? It is well known, that eggs may be kept fresh for a long time, by a coat of varnish: we might at least preserve from frost our shrubs, by brushing them over with certain kinds of pitch. Mr. Evelyn, recommends tar, for doing over young trees, to preserve them from insects.

73. M. de Jussieu has presented a memoir to the academy, in which he pretends to prove, that the life of plants resides in the pith, which extends itself to all the branches and buds. But whatever be the cause of the withering of the fibres, the only thing to be done is to re-establish their organization and suppleness, in order to resuscitate dead plants. These researches require a good many trials, a deal of patience, and an apparatus of good microscopes, &c. I imagine, that humectation might be productive of extraordinary effects; but, then, what liquid must be used for the purpose; with what degree of heat, in what manner, at what time, &c? several young trees, having been taken out of the ground, in order to be transplanted, but happening to be neglected for several months, they died, or were in consequence thought to be dead; but they were restored to life in the following manner; being laid to steep in a large
back,

back, in which the butchers had washed the entrails of the cattle they killed : they recovered by this water, impregnated with animal particles, in four or five days, a new vigour, as by a charm. I shall here moreover add, that a fine pear tree, being dead, or thought to be so, shot anew, and continued to do so from year to year, in consequence of a large dead dog being laid on its roots. By these facts I am inclined to believe, that we might possibly derive considerable benefits from the animal kingdom for the cure of our sick vegetables. I cease not therefore to invite the virtuoso's in agriculture to make some more experiments on this subject ; for certainly those, that shall succeed in bringing dead plants to life again, shall acquire from this, a much more valuable and endearing reputation, than from all the learned dust of the schools.

C H A P. VII.

Of Seeds.

74. **A**LL vegetables, doubtless, have their seed ; but many of them conceal it so well, as to escape the eyes of naturalists ; and yet we fail not to have such plants in plenty ; and our gardeners raise mushrooms at pleasure*. Truffles, as being a more excellent production, deserve to have their true origin discovered. The artificial plantations that have hitherto been made of them, are scarce worth mentioning. A virtuoso, who could furnish the world with truffle-feed, would make a fortune.

75. It

* See Ghiarefchius in Vallemont's Natural Curiosities.

75. It is now well known, that vegetables are male and female, and that a seed cannot be perfect, unless it has been fecundated by the male. This concurrence of the two sexes is generally found united in the same plant; but, as this happens not always we should labour to know exactly this distinctive detail, in order the more to procure the perfection of grain or seed.

76. It seems that at the time a plant produces its seed, it is in a state of labour, if I may be allowed the expression, and it is then, it requires the most attention and succour; and yet in these circumstances we always leave nature to herself; should she not be aided and watched in the critical moment? This time, so much neglected, is precisely the most essential; it is the principal end of vegetation; it is there all the functions of nature terminate. How many accidents may she not then be liable to? The smallest breath of air dissipates this seminal powder in the instant of its maturity. We may possibly owe many barren years to the neglect of a single moment: harken, to what I am about to say. There is, in the imperial summer garden of Petersburg, a Date tree, transplanted thither under Peter the Great, a hundred and fifty years old; and, for years past, has borne flowers, without ever yielding any fruit. It is a female, and its barrenness was owing to there being no male in its neighbourhood. The gardener having procured some of the prolific powder, which adheres to the antheræ, or apices of the male flowers, took the following method to fecundate the female. Having but a grain weight of this powder, which had been sent him from Carlsruh, and choosing the time, when his Date tree had but seven flowers; then, taking a very fine pencil, he gently laid some of this powder on, three times a day, for about three weeks; and, this operation produced above six hundred Dates. It is remarkable, that this powder was carried three hundred leagues by the post in the coldest weather. I imagine that this experiment should make

us advert to the moment in which the powder should be dropt on the flowers.

77. The Violliers, called QUARANTAINS, yield a seed, of which but one in forty, or at least one in a great number, yields a double plant. I have been assured, that, to procure a seed, that shall give only double plants, nothing more is requisite than to inoculate the shoot with single flowers, which is to give the seed, on a stock with double flowers. Though I do not warrant a trial, I have not myself verified, I cannot forbear proposing it, in order to give rise to thoughts, of which a happy application may be made. In other respects, it seems highly probable, that by engrafting any kind of branches, which are to bear seed, on strong and vigorous stocks, the seeds should thereby doubtless acquire a better constitution. See section 104.

78. The time of sowing is likewise something very nice. There are, who put their seeds to steep in certain liquors, before they commit them to the ground. These are waters impregnated with nitre, lime, dung, &c. Brine, by preserving the seed from insects, likewise facilitates GERMINATION. Some seeds require, to have their skins softened, each has a different peel, skin, rind, a different cover; and it seems, that as every crop depends on the seed, we should have a very ample and particular treatise on this subject alone.

79. There are some virtuosi, who make plants shoot, grow, and come to some size, in a few hours; and all this by means of the preparation of the seed. The method of hastening the unfolding of the germ has several advantages. Possibly, by this means, we might come to have two crops the same year, instead of one. And there are seeds, and nuts, that continue so long useless in the earth, we should gain considerably by abridging the operations of nature. We are therefore to make trials with different liquors. I shall here, as an instance, transcribe what the Abbé Vallemont, says on this head; set a bean,
says

says he, to soak for eight days in oil of olives, or in its lees; and it will shoot almost directly, if you plunge it into the crumb of a hot loaf. And he assures us, that with dung liquor, with earth well prepared, and a small degree of heat, we may have, in less than two hours what will make a very good sallad. I cite these experiments, in order to shew the possibility of some happy discoveries on this head, and of their valuable application in agriculture.

80. The mixing of seeds, may moreover produce agreeable varieties, as well as useful productions. Odours and colours may, it is said, be communicated by means of the seed. What a number of experiments, therefore, might we not make, in order to create, as it were, new species, and to vary and improve those we are already possessed of? We should employ ourselves in discovering, what drugs there are, which are capable of insinuating into the pores of seeds, and into the fibres of tender roots. Many plants partake of the colour of the soil in which they grow; the taste of the earth is also communicated, and some wines taste of the fire stone, or pyrites; because, as is said, they are produced amongst stones of that kind.

81. For what length of time can seeds retain their GERMINATIVE virtue? The ancients extended this term to forty years. But, besides, that each species of seed should be more or less long-lived, the manner of keeping them in store should contribute much to their longer preservation. For instance, when we want to transport them to very distant countries, in very hot weather, and even across the line, nothing more is requisite than to enclose them in glass bottles well stoppt, or luted, and then sink the bottles in water: seeds keep extremely well in this way.

82. But, when they have lost this germinative faculty, is there no possibility of restoring it? There are so many valuable plants, so many seeds, which we are every day forced to throw away; possibly some peculiar juices or vapours may be sufficient to recover them.

In fine, I repeat it, that the study of seeds, is still in its infancy; and demands the observations of philosophers. The Jesuit Ferrari, says, that if we mix several seeds of the same kind, but of different colours, in a case of Elder-tree, in order to deposit them in the earth, the germs will mix, and yield a plant variegated with many different colours. This trial might be applied, in order to vary in the same manner the odour, the flavour, and all the other qualities of vegetables, &c. Who knows, whether we might not sow seeds in the bark of some other plants; in the pulp of leaves; in the calix or amianthus of flowers; in the flesh of fruit; in the pith, &c? Only make the trial.

C H A P. VIII.

Of Slips, or Cuttings.

83. **I**F art has sometimes the better of nature, it is certainly in the use it makes of cuttings. Instead of following the ordinary course of planting young twigs, or sowing seeds, we cut a branch, which we thrust into the earth by one end, and we have a new plant equal to that from which it was cut. By this method, we save several years, and preserve precisely the same quality of trunk, much of which we lose in the way of seed. The grape, for instance, produces from its stones, only wild grapes, &c. these advantages should engage cultivators, to search out all possible means, in order to be able to use the same method for all plants.

plants. Several philosophers have pretended, that all trees might be made to come by cuttings. How happy a discovery for agriculture, should this practice succeed on all subjects: it might possibly be extended to herbs.

84. They are, generally, the porous sorts of trees and shrubs, whose branches, when cut to pieces, and stuck in the ground, take root without any farther trouble. Such are the Sallow, the Poplar, the Elder-tree, the Vine, the Gooseberry-tree, and all the pithy woods, which greedily suck up the water. This possibly depends on the disposition of the fibres, on the slight adhesion of the bark, on a plentiful pith; infine, on whatever indicates an extraordinary degree of openness in the vessels. Therefore, nothing more, perhaps, would be requisite, than to facilitate this evolution or unfolding, in the case of every other plant, and put them in a condition to imbibe a sufficient stock of moisture, before they put forth any roots; we might possibly succeed in this, by previously laying the ends of the cuttings in water, there to soak to a certain pitch; by the use of different liquors, with a slight degree of heat, or a different manure; by seasonably removing a portion of the bark or of the fibres of the wood; by inserting a few grains of barley or oats into the pith, or into the wood; by duely attending to the state of the sap; by introducing some of it into borings made in the cuttings; by frequently watering them, &c. there are a thousand trials to be made, from which we may expect success. I must here observe, that, in sticking the cuttings in the ground, we are to take care, not to meet with any flat stones, on which they might settle; as this would shut up in part the lower end, and consequently retard the passage of the moisture.

85. As a very pretty wood might be formed in a day, by planting, in sufficient quantity, cuttings of the Linden-tree, or lime; how useful would it not be, were we also to plant in a day, by setting slips in
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the earth, a forest of oaks or elms; equally useful and agreeable would it be to plant an orchard in a day; considering how quickly the boughs and sprigs of the wild Quince-tree take root, we may have the greater hopes to succeed with branches of the Pear or Apple-tree.

86. There are some plants, which we already know to come by this method; and, no doubt, there are several others, which only want the attention and assistance of some virtuoso, to procure us the same advantage. The application, which might be made of this discovery, would perhaps be one of the most valuable, we know of in agriculture. We might then bid defiance to cold, frost, and all those other inconveniencies, to which all young plants, so tender in their infancy, are exposed. Florists should here be proposed for models, and their success in their different layers or shoots invites to this. We should then become gainers, both in point of quantity, quality, and time.

87. I have seen a very fine Mulberry-tree, which was a large branch, cut from a large tree. The lower end was cut tapering to a point, in order to fix it in the earth, as a stay or prop to a vine-arbour. It was of the size of a man's thigh, and seven or eight feet in height, when fixed. I in vain put several questions to know precisely in what season it had been planted, if it had been a long time cut, and if the parent tree was in sap, &c. but, I could get no satisfactory answer, with regard to any of these circumstances, which I wanted much to know.

88. What has happened once, may happen again; or, rather, should always happen. All that is requisite, is to combine the same circumstances, and we may be sure to find nature always constant in her operations. We should, therefore, carefully study the causes, which concur to make a stake take root, and the different assistance, which each species requires; and then the vegetation will always answer.

89. We

89. We all know how easy it is to obtain Pine-apple plants, by planting the little tufts of leaves at the extremity of the fruit. The gardeners, before they put them in the earth, wait till they are faded and half withered. This observation may suggest some useful hints with regard to other plants, provided we can discover the reason for which they suffer pine-apple leaves to fade and wither. Perhaps, they are in that state more tender, and thus being flaccid and deprived of humidity, they the more greedily draw the ambient juices. Were they to be laid in the ground full of sap, they would not take into their turgid pores, supposed to be sated with the old, any new juices: and thus far from resuming life, this their state of freshness would be changed to a state of maceration and putrefaction, full as they are of a sap, of which they could not get rid. What I here say, being only my own conjecture, I invite naturalists to enquire into the truth of this operation; in order to the management of cuttings, which may have any analogy with the pine-apple leaves. We might, perhaps, by this means come to form Artichoke-beds with the wreck, or broken remains of the branches of a single plant.

90. But, as every genus, and even every species of plant, has its own peculiar qualities and wants, we must try, and again try; sometimes by planting leaves only, as is usually done, with regard to the *Opontia*, or Indian Fig; sometimes by separating the filaments of the little cutting at the end, by which it is stuck into the ground, as in the case of certain flowers; and sometimes planting the fruit. Potatoes are propagated by cuttings, each of which produces a stalk, issuing from the part where there is an eye, and forms a perfect plant. In fine, every part offers itself to the disquisitions of cultivators. When may we venture to say, that all trials are exhausted, and that none remain to be made?

91. As

91. As it is in the bark of plants, that the principal process of nature is carried on; as it is a change in the bark, which essentially constitutes a change in the species, as is evident by grafts; and as, infine, it is the bark, that annually enlarges the diameter of trees, and as a solution of continuity in the bark may bring on the death of the plant; it is upon the bark principally that the nicest trials should be made, in order to obtain both a theory and practice, adapted to all vegetables, both in general, and in particular.

92. I should here add the interesting discovery made on this head by M. Lignon, his most Christian Majesty's Botanist for foreign plants. This gentleman has found out the secret of provining or propagating by layers, every kind of plant: he took ends of branches, or sprigs, and put them in a phiol full of river water, which he shifted three or four times a week; and, by this means the young branches put forth roots. The great success he has had, should prevail on the virtuosi to repeat these trials. This method might, perhaps, be farther improved, and adapted to every kind of vegetable.

93. There are herbs, which, like trees, may be reared from cuttings: little bits of the tithymal being planted, have produced young plants. The characia's, the myrsinutes, the cyparissia's, and many others have answered equally well. What a remarkable epocha in the annals of Agriculture, to be able to dispose every herb whatever to take root with equal facility.

94. But, here I would be understood to mean all cuttings and slips, under what name soever: for, when one method does not succeed, we must substitute another. For example, we pare a branch, without separating it from its stock, bend it down into the earth, and secure it in that situation; and when it has taken root, we wean or part it from the stock: and I imagine, that this operation might be applied more generally and be made to answer quicker.

C H A P. IX.

Of Young Shoots.

95. **T**HERE are several trees, which, they say, never die without heirs. For instance, when a fig-tree, a bay-tree, a chesnut-tree, &c. happens to be cut down, be the trunk ever so withered and dry, yet several fresh, green, and vigorous shoots are seen to arise. It is plain, that the roots of these trees never wholly die, and from the living parts these new plants spring forth. On more thoroughly investigating this process of nature, we might, perhaps, come to get some good from the old roots of other trees, and even of herbs, which we now give up, as the plant is supposed to be dead.

96. What may be depended on is, that these shoots partake of the nature of the stock, on which another species shall have been grafted. Thus we see wild quince branches issue from the foot of a pear-tree; whence it follows, that the sap does not circulate, and that it is still, quite to the part of the graft, such as the root draws. On considering therefore the mixture of two species, as of two trees mutually existing in each other, the one is dead without the other being so; at least, if the mortal cause comes from above, the stock may continue to have life, when the part grafted is perished.

97. We might, therefore, make greater use of this regenerative faculty in the roots of vegetables, and procure a greater number of young trees from one of these stumps, which produce so many
H shoots;

shoots; and by disposing them for that purpose, a single root would prove a nursery, or small forest of cuttings.

98. Besides the shoots, which the roots yield, there are others, which issue indifferently from the trunk and the branches; such, as those, which the gardeners call *normands*. These, perhaps, might grow to trees, by being parted, with some of the bark, on planting them, in a proper soil, and at a proper season. It seems, nothing more is requisite, than to soften this portion of bark, and fit it to become afterwards a root.

99. Not only trees produce these shoots; but several species of plants. Some kinds of cabbages, for example, shoot out a number of young branches on every side, after being stript of their first growth; and in some countries they are kept, for years together, and thus made to yield several crops. There may be many other vegetables possessed of the like useful faculty, without our ever making the best of them; or, at least we might bestow this quality on those, which have it not; or, prolong it in those possessed of it already. Turnips, large radishes, parsnips, carrots, &c. produce leaves in abundance after they have been stript of their first growth. By sowing them early, and then cutting them, we may obtain successive crops of excellent forage, as long as we can preserve the roots alive in the earth. These plants are delicious food for horned cattle, and make cows give a great deal of milk. And what I have said on these, may be tried on a thousand others.

C H A P. X.

Of Grafts.

100. **T**HE practice of inoculation and grafting may be reckoned amongst the most entertaining discoveries in agriculture. When once we have subjects, they may be easily transmuted into all the species of trees we can desire. And, if not content with these, we may again metamorphose them to others, without end. But, it is to be lamented, that this admirable art, so easy, and withal so useful, is left to the rote of the blind practice of gardeners, who, to a man, regularly repeat this operation, just as their fathers practised it, without ever troubling their heads to bring it to perfection. And yet, what a number of curious experiments still remain to be made, either upon it, or with it? And, so far from attempting any, we have almost forgot those we owe to mere chance. Some shepherds, out of amusement, engrafted a mulberry on a fig-tree, or a fig-tree on a mulberry; and nature gave them a new tree, and a new fruit, before unknown. And, even the ficamore, delicious as it is, is at this day almost unknown in countries, where the mulberry and the fig-tree are common.

101. Should not this instance excite the attention of virtuoso's? How many new species might not be created by attempting a variety of alliances? As the florists, whom I always mention with complacency, have varied almost without end, the species of the

same flower. We are still strangers to the extent of nature's power in the vegetable department. We know, indeed, that animals produced from two different species can form limits, which cannot be surmounted; but this holds not of vegetable mules, if I may be allowed to distinguish by this name the new productions of two different plants. It seems, therefore, that it is possible with ease to multiply, to create new species, and perhaps new genuses, by wedding different vegetables together; since cultivation alone, produces such a variety in our flower-gardens.

102. There are so many barren trees, which would perhaps yield fruit, did we discover the art of grafting branches of fruit trees upon them. And, what may be expected from trees, which never bore any fruit, may be expected with better reason from those that have. The sap in the roots of vegetables, has perhaps greater affinity, in the species, the most different, than we imagine. It is by mounting up the stem, and across the fibres of the bark, the pith, the leaves, and flowers, it is elaborated in a different manner, in order to become a different fruit. On narrowly inspecting and closely watching the progress of nature, we may be convinced, that, in the same pot or box, we may raise a sweet, or a bitter, a wholesome or a poisonous plant, &c. The first elaboration is doubtless performed in the mouths or orifices of the roots; but, I say, that there the difference is not so essential, but that the sap may undergo another coction. This is what happens hitherto in all subjects, that undergo grafting. But, it is possible, that a plant, which refused to suckle strange grafts, when applied in the common way, might intimately unite with the same grafts, if inoculated on the roots.

103. After the trials made on the roots, come those, which may be made on the other parts of the plant. We might, for instance, refine on trials of new inoculations, by endeavouring to separate the

the several membranes of the bark, by parting the bark from the other coats that lie under it; and by performing the same operation on the graft. As each subject has its own peculiar covering, it is perhaps by removing a fine skin, or a slight cuticle, and substituting for it one of another kind, that we shall come to form new alliances. What a vast career opens here upon the imagination!

104. This practice should be treated with more delicacy than it usually is. The operation is scarce ever performed, but on hard and ligneous bodies: trees and shrubs are the only grafted subjects; we scarce ever hear, that a bush, or an herb has been inoculated: but, I continue repeating it, that the process of nature is the same in the hyssop and the cedar of Lebanon. Why attempt we not grafting all the plants in common use? For example, annuals, upon perennials; the weak upon the stronger and more vigorous. See section 77.

105. I own that to graft fine and delicate plants, an attention more delicate still must be used. But the plant, though sensible, is always immoveable, and stands every, the most painful operation. We may, therefore, make trials at full leisure; and repeat them on the bark, or rather between the different coats; on the stem, as well as on the roots, &c.

106. By extending inoculation to the minutest species, we may still vary them: I mean, that, as grafts of trees answer on shrubs, as the pear-tree on the hawthorn; bushes would perhaps, succeed on trees, herbs on bushes, &c. Cats and rats are said to have coupled: there is a much stronger presumption of succeeding in coupling the different species of the vegetable kingdom. On observing their time of sap, as we do that of the rutting and pruriency of animals; we have the opportunity of causing them to submit to any trials we please; very different
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in this from animals; plants have a boundless docility; of which learn to take advantage.

107. Could we not avail ourselves of foreign roots? I am going to explain myself: there are plants, that kill or choak all in their neighbourhood; there are others, on the contrary, which seem to communicate around them a vegetative virtue. After a crop of black corn, for instance, the field appears quite naked and destitute; but after a crop of oats, it is so full of grass, as to resemble a meadow. There are some persons, who avail themselves of this vegetative property of oats; when they set tender cuttings, or offsets in the earth, they thrust a few grains of oats into the part, which is to be buried in the ground; these grains quickly strike root; and these roots, in all probability, unite with and adapt themselves to the cuttings, or offsets, and perform the office of fostering-nurses, by them; till they have struck their own roots. This is what I mean by availing ourselves in GRAFTING, of foreign roots; a practice, which, if verified and thoroughly understood, might, perhaps, produce a number of new individuals; or, at least procure to many plants an opportunity of growing by cuttings. If the branches of all plants, set in the earth wither and die; it is certainly for want of nourishment: and thus, supposing the roots of oats capable of administering to them an early supply, they would have time to shoot fibres at their leisure, if those of the oats did not suffice. Thus, it should seem, that no branch of a plant or tree, could any longer perish or die, if supplied in this manner, with foreign roots, &c.

108. As the flowers of vegetables have need of fecundation by germs, (See sections 75, 76.) an operation still more delicate than any of the preceding might be tried; to give, for instance, to female plants a fecundating powder, taken from the male of some other species. It is the business of botanists to point out the proper

proper season, in which the stamina are loaded with germ; and what are the plants that require this assistance; and what are those that have the two sexes; as we might, in the case of these last, make trials, by depriving them of their own fecundating powder, and substituting another. Here again innumerable trials offer.

109. If every part of a plant suggests trials to be made upon it; seeds may also in their turn claim our attention: might we not inoculate one grain upon another; convey the germ of one into another? Let us, for instance, take a large bean, the parts of which fall better under our senses; after putting it in a moist place, the skin and coats become soft, the lobes swell and are easily parted, the germ increases in size, shoots forth, and begins to lengthen: might we not, I say, part and remove this germ, and lodge it between the two lobes of some foreign plant, moistened and softened in the same manner with it; and fitted to serve for the first nourishment, and for the evolution of the tender roots? This little manœuvre would, no doubt, require a greater degree of nicety, when performed on smaller seeds; but, then it might be attended with surprising success; in the same manner as in the ficamore, we might create new beings.

110. Bulbous plants, perhaps, would better than others submit to this trial; because bulbs perform, at once, the several offices of seed, root, and nourishment, and because they consist of larger parts, which may be easily divided. Open then these bulbs, to the second, third, or fourth coat, &c. convey this germ, thus stript, and which shall resemble a very small bulb, into the coats of another, from which you shall have taken the heart, or core, and which has an equal number of coats; then carefully fold them both up. I imagine, that these germs will each of them continue to grow, and probably yield a new species. The hopes of becoming creators, are well worth the sacrifice of some bulbs

bulbs of tulip, to be conveyed into those of the hyacinth, or tuberoſe: I ſpeak not in favour of florists only, but of naturalists in general, who, might here find ample matter of exerciſe, amuſement, and creation.

111. It is thus, that by intermixing different ſpecies, exotics with natives, good with thoſe more ſo, little with big, weak with ſtrong, by cuttings, graffs, ſeed, upon barks, roots and flowers, by means of ſap, juices, ſalts, aſhes, in the pith, the wood, the germ, the ſeed; by varying the ſoil, the manure, the culture; by repeating, in fine, one or more trials on the ſame ſtem: it is this, I ſay, that by eſſays repeatedly made, we ſhould ſucceed to enrich ſociety with mongrel or mixt plants, which have not yet had an exiſtence, and to improve thoſe we have already.

C H A P. XI.

Of Botany.

112. **T**HE knowledge of ſimples is, too dry and detached a ſtudy. The botaniſt is content with finding out the names of plants, thoſe they have now, and thoſe they formerly bore; he leaves to the florist the care of ſtocking himſelf with flowers. Gardeners ſhould ſearch out the plants that are fit for the kitchen; phyſicians ſhould ſtudy the virtues of the plants, they want to uſe; apothecaries ſort them; chemiſts analyſe them; farmers know thoſe they ought to cultivate, &c. But why does not the botaniſt

tanist point out to every profession the vegetables, the best adapted to it? Instead of being a barren science of words, botany, might then, and should, be made a general guide to almost all the arts.

113. I affirm not, that an herbalist is to dive or go deep into all the properties of vegetables; though this would render that science almost divine, and the benefactress of all the rest; yet this would require too much application; and man lives not long enough to answer that purpose. I could at least wish, that not content with being a cold, dry naturalist, a botanist added to the names of simples, the abridged and known history of each species.

114. Speaking, for instance, of spurge, called in Latin *LATHYRIS*, in German *SPRINGKRAUT*, in French *EPURGE*, &c. after giving all these different names, they should give the description of it, with its virtues, &c. In fine, it should be said, that, in some countries, it is usual with farmers to lay down their fields with it, and that to great advantage: as it is a most excellent food for black cattle; makes cows yield great plenty of milk; forms artificial meadows, which, are perhaps, the most commodious and useful of any others. They might add, that it is customary to tie down each beast put into these meadows by the foot, by means of a large stick, one end of which is fastened to the animal's foot with a small chain, and the other secured by a stake driven with a mallet, or club into the ground; that when the animal has eaten up all the spurge within his reach, the stake may be removed, and driven into a different spot. There is so much advantage in this oeconomic contrivance, that I could not forbear describing, and recommending it, as fit to be followed in every kind of meadow, and in every place where forrage ought to be saved. From this short relation, many, who never heard of it, will learn the use of this valuable plant, and

be taught a simple and easy method, by which to feed double the number of cattle with the same quantity of meadow. It is by means of such seemingly trifling details we shall come to enrich whole countries with a production, perhaps, highly necessary for them. If I mention a pole or stick, it is because in some places they use cords or chains for the purpose; which are attended with great inconveniencies. In fine, let it be added, that this plant is sown in the same manner as trefoil, or flax; and that, so far from interrupting other crops, it adds to their goodness, &c.

115. I say, that, by thus relating the different uses, to which different plants are applied in different cantons, we shall enrich others with a detail of numberless conveniencies and advantages. Peasants, in other respects highly ignorant, and never travelling to other countries, could know nothing of the matter, without such assistance: and possibly the example of other nations, accompanied with an unexpected success, will draw them off, from their obstinate old practices, from which they have such difficulty to depart. For instance, there is published this year, 1768, at Parma, a memoir on a plant, called *SULLA*, or *SILLA*, with which artificial meadows may be made with scarce any trouble attending. They sow it on the stubble in *MALTA*, and at *SEMINATA*, in Calabria. This is a very important anecdote for agriculture, from the great facility it offers of cultivation.

116. Florists, might also adorn their parterres with new flowers. The little centaury and the euphrasia, or eye-bright, do not a little resemble the smaller shrubs, have a genteel air, and a pretty livery; so that, could a virtuoso contrive to make them grow to a greater size, and yield double flowers, they could not fail figuring surprisingly in a vase or pot. There is an herb very common in standing corn, called *VIOLA SEGETUM*, corn-violet, which might likewise become a new ornament to our parterres. The *SAPONARIA*,
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or soap-wort too, considering its colour, and particularly its smell, is not unworthy our attention, as likewise the orchis, satyrium, or rag-wort, &c. In fine, what numbers have we not on our mountains, and in our forests, not to mention the many charming, exotic plants.

117. I barely suggest a hint, inviting others to improve it, extend it, and above all, add new hints to it. I shall propose one in the botanical department, which should, I think, engage the attention of all our virtuosi. Those, who form botanic gardens either for their own amusement, or the instruction of others, are at much labour and expence; and what comes all this to? It is only by the greatest precaution, that exotics are preserved in green-houses, or in hot-houses: those sown or planted in the open air, require also labour and expence: and yet both die away each year, one after another: the most exquisite assortment or collection is never compleat: in fine, those plants which thrive best, and hold out longest exhibit only a momentary spectacle to the diligence of the botanist. Simples can never be in flower but once a year, and the time of flowering differs in each species; and, this moment once past, they no longer offer any thing but the cold insipid view of stalk and leaves; so that we never have but a part of the productions by intervals in review. Now to remedy all these inconveniencies, I have imagined an artificial botanical gallery, quite agreeable to the eye, and which would admirably well answer all the purposes or objects of this study. The skill of Italian hands imitates, if not surpasses perhaps, the natural flowers. On this model, might we not with greater facility imitate the entire plant. Cause them then to be represented, one after another, in their most perfect state, and each artificial plant to have its own vase or pot filled with sand, taking care to give each its proper fruit and seed, with a representation of its root. Each part being thus copied after nature, you might pre-

serve these vases or pots in glass cases, disposed against the wall of your gallery; dust is the only thing, against which you are to secure your herbs and flowers. Each pot or box should include all the names of a plant, with a detail of all its circumstances; all which might be easily read through the glass, without opening the cases. But did we want to go deeper, we should find in those vases or drawers, the compleat history of each simple, its native country, from which it was originally brought, which I consider as a very material, though much neglected circumstance; its known virtues; but, above all, the different uses to which it is usually applied. It is this last article in particular, which is purely historical, we should make our chief business to bring to perfection by proper enquiries, and by means of the relations of travellers. In this way, we might go through a course of botany under cover, in winter, as well as in summer; and to much greater advantage, than in the best stocked garden of Europe, &c. I need not enlarge on this hint, its agreeableness to the eye will surpass, I imagine, the richest tapestry, and its usefulness, for the purposes of instruction, must satisfy every possible enquiry.

118. These artificial plants might be made with the cones of silk-worms, as in Italy; with paper, cere-cloth, wax, plaster, leather, and several compositions, &c. Had we but ingenious workmen, who could imitate them in iron, or tin-plates, on which were laid the colours peculiar to each part, and then passing a varnish on the whole, secure to ourselves everlasting plants; such as might occasionally be brushed and washed, and even exposed, now and then for some time to the open air. The fruits, seeds, and some other productions might be imitated in paste, or in wax, which yields so readily to every form, and so admirably retains all the colours. We might imagine several gypses, fat earths, paper maché, and

and a thousand other materials to be employed, according to the particular taste and judgment of each person.

119. What I have been saying to botanists, I repeat to florists; who, without taking so much pains, too much for a member of society, who has so many other indispensable duties to attend to, and without toiling so much for flowers of a few days continuance, might, I say, procure to themselves artificial parterres, more variegated, more striking, and more charming to the eye as well as a thousand times more lasting, than the natural ones; and a small distance would be sufficient to keep up the charm and illusion to the spectator's eye.

120. The artificial gallery, I have been proposing, by forming a prospect variegated and enamelled with every agreeable colour, might besides exhibit in each compartment an index of the works, which treat most particularly on any single, and thus each compartment have its own little library. It is thus, that, by means of botanical books, and of the relations of travellers, and the memoirs of chymists, artists, and other authors, a course of botany may be gone through, to much greater advantage, than by means of those cuts or pictures, with which old botanical books are charged.

C H A P. XII.

Of the Commerce of Plants.

121. **T**HIS article concerns the statesman, no less than the naturalist; yet it is very far from being considered as much as it deserves. Scarce ever do we reflect, that three fourths of our merchants have

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no other object of commerce, but plants, and their productions. It is well known, for instance, that all cloths are made of the peel or skin of hemp or flax; and which, when worn out is made into paper, &c. But yet, we do not sufficiently reflect on these things: It might, perhaps, be as easy to extend the uses of vegetables, to improve them, to render them more common, and to substitute them for other materials, which are more scarce and dear.

122. There is scarce any of the dying woods we get from America, which might not be replaced by some other plant of our own climate. We have seed or grain in our fields, which, if properly roasted, might supply the room of coffee; snuff might likewise be made without using any tobacco; and there are people in some countries, who make wine without grapes. I have been assured, that a shop-keeper in a great city, sold a vast quantity of tea, at so low a rate, that every body bought of him; the other tea-dealers jealous of his rapid fortune, and not finding on the custom-house books, that he paid any duty, obliged him to declare in a court of justice, whence he had his tea: he owned, that it was the leaf of a plant which is every where to be had in great plenty; which he had the art of roasting and drying; and of imitating so well the common tea, that the fraud could not be discovered, had he not owned it himself. I shall be very careful not to reveal such tricks; but, what might be roguery in a merchant, might prove an inexhaustible mine in the hands of wise statesmen. The use of tea and coffee was lately prohibited in one of the German states; a prohibition so wise would prevent the exportation of money: and by introducing the use of some other beverage, which might imitate and replace that which was to be proscribed; a barter so ruinous, and at the same time so ridiculous, of gold for herbs would be prevented, and none be found to complain, and the state be really a gainer

gainer each year, to the amount of the sums gone out on such foreign trifles.

123. The commerce of plants, is so immediately connected with their use, that the policy of every wise government, should be, to direct the former, properly, and form a thorough knowledge of the latter. Silk, for instance, is become an article of necessity, to such a pitch is luxury grown, since the introduction of the silk-worm from Asia. Now, if our rulers could be once made sensible, that the mulberry-tree grows and thrives in every climate, even in the coldest; they would invite by rewards, and even force by penalties, the farmers to second their views, by planting it; and then, our public roads, instead of being bordered with barren timber trees, might be more usefully set off with mulberry. Nay, every courtyard, every spot fit for them, should be planted with these trees. And supposing, that after stocking a country with them, the leaves, from the inclemency of the climate, proved coarse and harsh; the silk would probably be less fine; but yet we should still have silk.

124. The wisest policy of any nation, is, to lessen its dependence on its neighbours. When any state is obliged to buy from another, at an extravagant price, those commodities, which it might have of its own growth, naturalists and the farmers are as much to blame as the people in power. Silk and wool, for instance, being capable of being produced in a country, it is the business of agriculture, and of those skilled in the management of cattle, to procure them in as great quantity, and of as good quality, as the climate will permit; both should be encouraged by royal bounty.

125. In speaking of silk, one of the most valuable articles of commerce, I must express my surprise at the paucity of the trials made with regard to it. Silk-worms are fed with mulberry-leaves, which shoot very late in the year; and by that means are subject to much inconvenience. Why, therefore, not look out for some more common, more easy,
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more cheap food for these insects; and less subject to disappointment by untoward seasons: besides briar tops, on which they feed very readily, they live commodiously on elm and fig-leaves, but especially on lettuce. The extraordinary facility, with which these leaves may be had, would be a great advantage, even in countries, in which the mulberry-tree abounds. What food more ready and more economical? Whole fields might be sown with lettuce. This food so commodious, is perhaps not the only one: how many herbs, how many leaves have we not to try, and what advantages might not result from the success of one single essay?

126. There is a kind of cotton, which grows even in the northern countries of Europe, and which may be used instead of the ordinary foreign cotton. Besides that cultivated in Sweden, by the name of *SALIX*, there are several plants, especially the marshy, which bear a kind of wool or silk, lying neglected, and abandoned, and which no one attempts to make use of.

127. I am surprised that no-body has thought of bringing over to Europe any seeds or young shoots of those reeds, which we purchase so dear for walking-canes. As they probably grow half in water, this element, as was said (See section 30) being subject to very little variation in point of heat, we might, perpetuate the species on the sea-coasts of Europe.

128. Several plants have been already discovered, which supply the want of oak-bark for tanning hides. The naturalists of each country should make observations on the productions within their knowledge, which may supply the scarcity of oak: and what I propose with respect to tan, ought to be understood with respect to all manner of uses, for which every canton employs its herbs, its trees, and its bushes; its ashes, potashes, and so many other things of that kind, which form a grand object of commerce. We observe in most forests, a great number of old trees, which there perish, at
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the time that we purchase at great expence, in distant countries, the ashes, which they might yield.

129. Besides all the succours, which either the agreeable or useful arts derive from vegetables, and besides those which are destined for the food of men and animals; those of a medical nature, form no inconsiderable branch of commerce. The policy of the loyalists or jesuits, which had so long concealed from us the Peruvian bark, failed not to make their advantage of it, as of a rich mine. Could we not transplant the China-china into those stoves, where the pine-apple thrives? Or at least, why not substitute for it some other plant, a native of our own climate, more suitable, perhaps, to our constitutions? The bark of the fallow has been lately found to be an excellent febrifuge.

130. But, what our naturalists and botanists are most to blame for in this respect, is their not having as yet procured rhubarb in such quantity as to answer the daily and pressing calls of European dispensatories. This root, which we cannot well do without, grows in cold climates, so that nothing can justify our neglect of it. But, without launching into a detail of all the foreign drugs and spices we now use, there is not, perhaps, a single one, that we might not do without. Physicians condemn the use of most of them; and yet every year drains us of considerable sums to purchase them. Here reflections croud in upon me.

131. Sugar, of all foreign productions, forms at present the most general branch of commerce; and I am well persuaded that our taste allured by, and accustomed to its sweetness, could not brook the want of it, did any sovereign proscribe it his territories. And I am likewise persuaded, that the canes, which produce it, would with difficulty thrive with us; though they succeed in some of the American islands, where the heat is not so excessive. But, since we have found, that the juice, the sap, the essential salt, of some of our

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kitchen plants, and of some of our trees, are possessed of a sweetness approaching that of sugar; why not bring these trials to perfection, and multiply the plants on which the trials may be made? The sap drawn by boring from the maple-tree, and afterwards thickened, affords a kind of syrup, which might, no doubt, be refined, and brought to vie with sugar. A sugar of a very delicate nature, has been procured from perry. But, these trials are still in their infancy. Chymists should here lend their aid. The analysis of salts, the figure of crystals, the combination of principles, might discover the plants on which these trials and experiments might be particularly carried farther. It would be highly agreeable, to be able to sow our fields in Europe for sugar, as we sow them for oil. I make use of this comparison on purpose, because in those countries, where the olive-tree abounds, and walnut-trees are common, the common people know not, that in other parts they sow several acres together with different seeds, which yield a crop of oil.

132. The uses of plants are no better known than their properties. Nevertheless, when we search into that antiquity, which modern pride disdains, we meet with accounts of the prodigies wrought by simples. A naturalist, an honest and candid observer, ought to confess, that there are no inutilities in nature: inutility is a greater absurdity than chance. The supreme artist, whose works a philosopher is never tired of admiring, could never do any thing without reason, without motive. I speak not only of each single production of nature, common sense dictates, that the whole was planned for some end. But, I believe, that the different qualities of these productions must be such for some reason; I mean the form, figure, colour, and external appearance of beings. Man, when left to himself, sits down to investigate the properties of plants, what other guide does nature give him, but only the figure and the other apparent qualities. But, I pretend not to support the opinion of I. B.

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Porta, and of so many other naturalists, who pretend to discover a sensible relation between the virtues of a thing and its figure; I only ask the botanists, if a plant, which exhibits such a figure, well known to every eye, is not always sure to be possessed of some particular virtue relative to that figure. I choose not to give a long tedious list, but I invite each naturalist to verify this proposition himself. True it is, that there is a great number of herbs, of which we do not directly discover the figure they exhibit, and the relation they bear to other beings; but good physiognomists, I mean the philosophical botanists, may discover this relation, and enrich the present and future ages with their remarks.

133. I cannot but say a word or two on the commerce of grain. It is every where a subject of dispute. The French have made it long a point to forbid the exportation of corn, and have often smarted for it. The English have allowed, nay rewarded it; and they have smarted much worse than the French. I imagine, that both nations are in the main in the right, but wrong in point of form. The latter, to encourage agriculture, have allowed a bounty on exportation; but, instead of rewarding the industrious farmer, which they had in view, they have only enriched a set of harpies, of monopolizing merchants, who have raked the corn from every quarter; and, sure of the promised bounty, have exported it to the neighbouring countries, to be there in constant readiness to be brought back again and sold at an advanced price to their own countrymen: but, may I be allowed to offer a word or two of advice to the wisest nation in Europe; it is in the fields, and amongst the farmers, we are to endeavour to excite emulation; the best cultivated lands, the richest crops, should be entitled to prizes; instead of bestowing them on a set of avaritious merchants, who scarce know how the grass grows. I must likewise take the liberty of telling the most polite nation of Europe, that they have almost as many books or treatises

tises on husbandry, as they have husbandmen, but it is not in the closet, a man can become a good farmer; that the hand which never held but a pen, must not pretend to direct that which is to guide the plough; that whilst three fourths of our writers are taken up in dictating laws, and prescribing rules to the farmers, one third of the land of the kingdom is suffered to lie uncultivated; I must be free to tell, that every thing should tend to the encouragement of the farmer, and since the leave to export grain becomes a new incentive, it should be granted entire; but then, some provinces should not be exposed to famine; every district, well policed, should have its stock of corn nearly equal to its consumption; and this stock should be annually renewed, &c. But then, I must repeat, it ought not to be under interested management, as is commonly the case.

C H A P. XIII.

Of the Productions of Plants.

134. **B**ESIDES the roots, the stems, the bark, the leaves, the fruits, and the seeds of plants, which are every where in use and demand, most of them produce other substances, the use and commerce of which should be in great consideration: their gums, balms, tears, resins, become salutary remedies in the hands of the skilful physician; nor are they without their use in the arts; of this the
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great consumption of them by the perfumers and japanners, and in so many other trades, is a pregnant proof. I choose not to speak in this place on all these known properties, but only propose those runnings of plants for observations of another kind. We should first ascertain, whether these discharges are from any indisposition in the vegetable; or, whether on the contrary, they are not salutary evacuations employed by nature, in order to get rid of a superabundant or too glutinous a sap. We should, next, enquire into the means of putting a stop to, of prolonging or increasing this discharge, in proportion to the service it might do the health of the plant, or to the benefits we ourselves might derive from it. These productions might, doubtless, be multiplied, and perhaps our care might reach to bring to bloom in our gardens the foreign poppies, and bring to consistence a perfect opium under our eyes.

135. To these exsudations of the vegetable juices, I should add those other excrescencies we so often find on trees. They may be considered as the warts and wens on our own bodies; are the agarics, champignons, mosses, and liver-worts of different kinds; these are the mistletoes, polypodiums, maiden-hairs, and the many other parasitical plants; and they are those beings lately discovered, known by the name of gall-insects, which, though real animals, seem at the same time to constitute a portion of the vegetable kingdom; in short, they are all those foreign or extraneous bodies, which I propose to investigate, for the advantage both of our dispensatories and our manufactures; or for the treatment and cure of the plants, which are infected with them. With a good microscope, an attentive and discerning naturalist might be sure to find on the bark of some old trunks, a rich field for a course of botany or a natural history. Whence come the seeds of all those little plants, as different from each other, as they are from the plant on which they feed? and what is very astonishing in the parasitical plants I have been speaking

speaking of, is, that they preserve their freshness or verdure, after the subject, upon which they feed and live, has lost its leaves; and, to a vulgar eye, its sap and juices. The ivies, the polypodiums, the mistletoes, the mosses, the maiden-hairs, and the other parasitical plants are of a beautiful green, in the depth of winter, whilst their fostering-plants are dead, or at least seem to be so.

136. I now return to the treatise of physic, I propose to execute for the use of plants. Without the help of magnifying glasses, we discover their organs, and in a manner perceive their operations. Were the anatomy of the human body, were physiology as much within our reach, we should no longer build vain systems of pathology; all our disorders would be manifestly known. Vegetables therefore having the advantage of being so much better known, should expect from our care every assistance imaginable against all their evils. They might even be brought to life again, when dead, in case the cause of their death has not made irreparable ravage upon them.

137. I have already spoken of the good effects of butchers water, impregnated with animal particles; but I should add, that these virtues reside more particularly in the head; human skulls and horns of animals are what contain the greatest quantity of volatile salt. One of the ablest gardeners in Europe carefully collects all horns, &c. which he burns, and by means of these ashes performs wonders, in which none of the other gardeners, unacquainted with his secret, can vie with him. These volatile salts astonishingly accelerate vegetation.

138. Amidst so many advantages, which we derive from plants, one, the most considerable in the common uses of life, is that of cloth, thread, and cordage. It is from the peel or rind of two or three plants that we fabricate or manufacture them: and yet, it is probable, we might use a thousand different herbs, which might
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render us the same service; but, such is the power of habit and inveterate custom, as to tie us down to a known small number. There are so many simples, which we cannot break but with difficulty; but from the resistance of the peel, we should conclude, that after certain preparations, we might employ it for cloth and cordage. The best method of steeping flax would be an excellent subject, and fit to be proposed to our naturalists. If we but knew how to adjust this occasionally, or in proportion to the resistance of the plant, in point of time, and quality of the water, we should come to subject three fourths of our vegetables to the cards or combs of the carder: and thus cloths would become more common, &c. There are two plants in the Brazils, called GRAVATA and PICU, the thread of which is excellent for cordage and cloths, with this advantage attending, that they grow without culture.

139. We use a great deal of powder and starch, all which we constantly draw from our most useful grain. Why not prohibit the using wheat for this purpose, whilst we have a hundred other things that would answer as well. Potatoes, and several other roots, particularly that of arum, or wake-robin, afford the finest starch; and Indian horse chesnuts, so common and so useless, yield it in great plenty. With regard to these last, I shall add, that they may answer a thousand other purposes which we neglect; after a certain lotion or lie, they are very good food for poultry; they are fit to scour with instead of soap; are a cephalic remedy, &c.

140. In several countries they distil spirits from grain; a beverage not very wholesome, not to mention the scarcity it often causes, and the high price of bread. An use so pernicious might be prohibited, without depriving the people of their favourite liquor: All seeds and berries, all parts of vegetables, which admit of fermentation, may supply the distillation of corn. These productions are so numerous, and, like the berries of the elder, are in great plenty,
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and may be easily multiplied, and yet they are much neglected. The Caribbees draw from potatoes a spirituous liquor, which is more agreeable to the palate than spirit of grain. Why not copy after them?

C H A P. XIV.

Of the instruments of Agriculture.

141. **I**T would be highly proper, that some naturalists, aided by mechanical knowledge, took a survey of all our implements for husbandry, generally left to ignorant and gross people; it is evident they have not that perfection which they should and might have: if a man of genius and learning happens to cast his eye upon, without ever vouchsafing to put a hand to them, he can never know, but on the testimony of another, the faults to be corrected, and the improvements to be made. The new invented ploughs, which have made so great noise, neither satisfy nor fulfil all the views, we had a right to expect from them. We lately saw in the public papers a notice of one invented by M. Finotti, of Ferrara, about which nothing can be said, as we know not whether it executes all that is promised about it. In the mean time, I propose a means of improving all these machines, the same with that used by the Romans, in order to attain to that degree of superiority, of which the astonished world will for ever retain the memory. Whenever they were at war with any nation, to the thirst of conquering they
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added the steady attention of studying their manners and customs; and, laying aside all the prejudices, which make us fond of our own practices, they adopted those of other nations, which appeared to them better adapted, and attended with greater advantages than their own. Considering, therefore, how well this method succeeded with them, I think the best thing we can do, is to make a collection of all the ploughs now any where in use. An academy might afterwards estimate, without partiality, their comparative advantages, and bad inveterate practices would be reformed by authority. It is thus, that in some provinces the cart-wheels have lately been ordered to be made larger and broader, after the wise model of the English wheels, for the benefit of the roads.

142. Various methods of threshing corn have been devised, but not yet brought to perfection. Might not one be contrived, which should have nothing but the ear to act on. The repeated blows, often so uselessly laid on the whole plant, crush and bruise the straw, of which better use might be made, if preserved. I have some notion of pursuing this thought, as also of contriving a scythe, which shall cut down four or five times more grass than the common. It is plain, that, in the present method of mowing, the mechanical forces of the human body are neither combined nor distributed with all the art and œconomy possible. Let us, for instance, compare the efforts of a man sitting in a boat, who moves a long oar, against the violent resistance of the water, with that of a mower; we shall be sensible how much advantage the long arm of this oar will gain by its point of support or prop, over the handle of the scythe, which has no such prop or fulcrum.

143. It is very certain that the implements of husbandry, which are generally every where the same, have, however, different proportions in different countries; and it is this difference which I propose to examine, because it is often productive of considerable

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effects.

effects. It is well known, that by moving the fulcrum of a lever, and bringing it never so little near the weight, or lengthening the arm, its power is greatly augmented ; all this is well known, and yet things are left in the condition they were found in.

144. As a proof of the empire of habit and inveterate custom, I must here take notice, that, in one of the best policed countries of Europe, in which the fine arts reign, and the sciences flourish, especially mathematics, in which books, knowledge, and authors do more abound ; in which, the geometrical spirit bears sway, if I may be allowed the expression, over every production of the learned ; yet there is not to be found a single, either wind-mill or water-mill constructed with all the proportions which mechanics require. There is not, I say it, in all this vast kingdom, a single ARTIFICE, a term denoting an edifice with a working or moving machine, that is not imperfect. People derive not all the advantages they might from the forces employed in them. Friction is not sufficiently guarded against ; nor are the proportions properly regarded. I am aware, that the execution and direction of these works, gross in appearance, are entrusted to carpenters and handycrafts people. But it is this very apology, which should condemn the nation : the ablest men are employed to construct our gates, our façades or fronts, and to lay out our gardens ; whilst our mills, a thousand times of more consequence than the symmetry, decoration, or elegance of a portal, are abandoned and entrusted to the ignorance of an inveterate practice acquired by rote.

145. I had almost forgot to take notice, that most of our utensils or machines, invented or perfected, remain buried in the memoirs of some academies, from which, surely farmers will never go to fetch them. Scarcely will five or six learned men come to the knowledge of them at the end of two years after the discovery : and, unless the reputation of the author shall prolong their fame,
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the rest of the learned seem to take no manner of concern about them. But if a thing is good and useful, it should be given to the public; it is in the fields that we should spread every thing which relates to husbandry; to the artists and artisans we ought to carry the discovery of any invention: but unhappily those who have not the merit of being authors of a thing, pay no regard to it, and often even despise it: it is therefore the business of academies to revive the good things, which lie dormant in books, and in the memoirs of their society; it is their business to diffuse them, to make the prime minister and the public sensible of their utility. A discovery generally unknown is dead to society.

C H A P. XV.

Of Manures.

146. **M**ANURES are in agriculture what money is in a state; by their means we accomplish every thing, we multiply the productions, we improve barren and uncultivated lands. We diffuse the principle of life, where before was only seen a desert, sand, gravel or rock. We cannot therefore study too much the nature of manures, their manner of operation, and above all the means of procuring them.

147. Each portion of the animal kingdom, however lifeless it may be, becomes the organ of fecundity to vegetables. Burnt,

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pounded,

pounded, wasted, or rotted, the most contemptible animal part is a valuable manure: but, as animals differ infinitely, their excretions have properties essentially distinct. It is of this variety that the classes should be determined; to the different dungs of each species of animals should be assigned the different degree and rank, in which nature confines each of them. Though they all have a general aptitude to fertilize land, yet some of them are hot or heating in the highest degree, while others are such in a much less degree. Some are cooling, others moistening. In a word, their functions being sometimes mutually opposite, they are themselves equally opposite. Pigeon's dung is said to be the hottest of all; but I imagine the dung of swallows is incomparably hotter. It is to the making observations on these different classes, their relations, their uses, their mixtures, and above all, their effects, we should invite naturalists.

148. As all the world know the great diversity there is in lands, we should thence conclude the diversity of their wants. But, independent of those distinctions, which ought to be made for the soil, we should besides consider the different productions which we want to draw from them. By this we come to understand the number of advantages which might be derived from an exact analysis of manures, either for the purposes of œconomy, or of fertility; by proportioning with a just distribution the salts, we should, doubtless, come to repeat over again certain prodigies of fecundity; such as are several phenomena of an astonishing vegetation, taken notice of by some observers; could not an enlightened philosophy effect at will, what chance has so often done?

149. As the richness of our crops depends principally on manure, natural or artificial; it should seem, that all the attention of the farmers should be fixed on procuring a greater quantity, or at least on carefully preserving what they already have; but, pray observe what

what happens; at every farm-house, we see heaps of dung piled up at the door of the stables, in order as they say, to give the straw time to rot. The country-people wait the time of putrefaction, before they remove this dung to the field; I own that in this state it is better; but in order to procure a small advantage, they risque a vast loss: to shew this in a palpable manner, I am going to make a proposition, as by way of experiment, which will plainly shew their mistake. Instead of piling this dung up in a corner of their courtyard, propose to your farmer to convey the dung on the field; this heap being formed, prevail on him to carry it the day following to a neighbouring place, on the morrow make him shift it again, and thus successively laid every day on a different spot of this field, it requires no more than a night's stay in each place, and without leaving any where any sensible part of this dung, every part on which it has rested will be sufficiently dunged. I propose not this as a practice to be followed, but to convince farmers, that every moment of day and night, there is a draining, a dissolution, a depredation of the nitrous and fecundating particles of this heap. Besides what the water carries off at bottom, it moreover undergoes desiccation by the sun, by winds, by the ambient air, &c.

150. Besides that the continual loss of the substantial parts of these heaps of manure exposed to the open air, is not the only thing I have to reproach our farmers with; I must put them in mind of their overlooking a very considerable article; of all the excretions of animals, the urine is precisely that which contains the largest quantity of salt; yet, all to the small quantity of it which is soaked up by the litter, the rest is suffered to run to waste. Now, to convince our farmers of the very advantageous effects of urine spread upon land, I need only bid them consider the produce of a field, in which any great number of cattle have passed a night; let them pen up sheep, for instance, and observe how thinly spread their
dung

dung lies, and they will not fail to perceive, that the plentiful crop which that year that spot shall yield, is principally owing to their urine. Let them, therefore, build their stalls and stables in such a manner as to preserve this manure.

151. I shall say nothing of the different earths used for fertilising fields; scarce any book in husbandry but mentions marls, and the methods of using them; I shall only say, that perhaps, there is scarce any one earth, which may not be manure for another; and I add an observation, which no one makes: that in liming or marling a field, it is usual to lay the lime or marl in heaps, with the view to expose them to rain and snow, and to undergo all the solution necessary to qualify for fertilization. Now, I cannot think, that any one, without the prejudice of a practice by rote, could imagine a more erroneous method. If we want that air or water should penetrate and dissolve a part of the marl, is it not more natural to expose to air or water a greater number of parts, instead of the surface of each heap: the surface, indeed, shall be penetrated, but the inside, which constitutes the whole mass, has not had a drop of water, nor so much as felt the air, the action of which is thought so necessary for its preparation. Common sense, therefore, dictates the spreading the lime or marl the whole extent of the field: but if we wanted to screen them from the impressions of rain or air, we should lay them in heaps, as is the common practice. Ask your mowers, in what manner they endeavour to secure from rain the hay spread over the meadow; they hurry to lay it in heaps; because, if the bad weather comes on, the surface only is exposed to it.

152. Those that can procure brooms, heath, and other untoward shrubs, think they do an ingenious operation in burning several bundles of these plants, the ashes of which they afterwards spread on their fields. Chymists tell us, that there is some salt found in the decomposition of all vegetables, consequently the ashes of these plants undoubtedly

doubtedly contain salts: but, I ought to represent to these persons; first, that this small quantity of salt is not the thousandth part of these bundles; and if so, this their assistance must be very moderate. Secondly, that this salt, speedily dissolving, is strained through the earth, and thus being carried far from the roots, is of no manner of service*, especially on a light and spongy soil: I make this remark, in order to prevail on those, who have any ashes, to spread them on their land at the time in which the vegetation is beginning, and not four or six months before, as is usually done. Thirdly, I represent to them, that all bodies which have passed through the fire acquire a degree of dryness, hardness, and incorruptibility; qualities, the very reverse of those we look for from manure. These ashes, therefore, all to the small portion of salt they contain, are become subtile and incorruptible bodies, of the nature of glass, or, if you will, of pounded bricks; so that, instead of being useful, they must be very detrimental, as they can no longer change their condition, or at least require great length of time to do it in. Heath, in its natural state, would be a better manure, though perhaps, the most meagre of all, and requiring much time and moisture to waste or rot in: such opposite considerations, as these, can never justify the use of ashes, the substance and moisture of which are dissipated by the fire. These vegetables contain earthy particles, which may be easily converted into earth; the good effects from which, lands would feel much longer, than from the transitory aid of the small dose of salts extracted from them.

153. It is universally allowed, that besides the excrements, the very bodies of animals are a wonderful manure. Yet, this is a constant practice, and which at first, I own, caused much astonishment: it is every where the custom to drag far from towns, and out of the reach of dwellings, the bodies of dead beasts; I have seen fields,

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* See the new system of manure.

to which several hundred horses, or other animals were dragged, whose scattered bones, and remains of skin announced the great number; I have seen, I say, that spot parched, barren, dry, and so meagre, that we could scarce discover on it a few herbs, stunted in growth. Any one may every day verify this sterility. In order to the parts of animals becoming a manure, it is, perhaps, necessary that they should first turn to earth; as this maceration or putrefaction develops or unfolds the salts which nature is to employ. In this case then, these animals should always be buried.

154. I say then, that if we except metals, there is not a single production in nature, which is not a manure, or at least capable of becoming such; the calcarious fossils, shells, all vegetables equally with animals. True it is, some bodies require some preparation by fire or by water. Hence it is evident, that the idle and indolent only can be in want of manure. I appeal not only to chymists and naturalists, but to every person of any activity and industry.

155. I shall here cite a very common fact, and which perhaps is not observed in this point of view: mosses are plants, of which botanists distinguish a great variety of species; but here I mean to speak of that moss, with which meadows too old are apt to be overrun. This then is an herb, with root, stem, branches, &c. like any other plant: if then I intended to rear a beautiful moss, large, plentiful and plump or full, it should seem, I ought to dung the spot: by no means: on spreading dung on a meadow, the moss is choaked, killed, disappears. We might be apt to think, that the hay or the neighbouring plants, by receiving from this manure more nourishment, strength and vigour, the moss was stifled. But that is not the reason; observe, that it is the dung alone, which acts immediately on the moss, and the spot on which it was laid continues for some time bare; the moss is all of it gone, for some time, before any grass springs up in the room of it. In what manner,

ner, then, does this manure prove the death of one plant, and the life of another? It is possible, that the vegetation of moss requires but a small quantity of juice, and that a very poor and meagre sort; in which case all kinds of manure will make it die of indigestion.

156. Some years since, we had an account in the public papers, that a manure was to be had at Francfort, a pound of which was enough to fertilize an acre of land. A naturalist will observe, that a composition of nitre, lime or other salts, will give the young plant, whose seed was for some time steeped in a solution of them, a degree of vigour; but this can have no influence on the crop. The small stem, which has sucked up at its birth all the juices of the manure, which is soon drunk up, finds itself all of a sudden deprived of the good nourishment, to which it had been accustomed, and perhaps worse off afterwards. To have a fat hog, it is particularly towards the close of his life that he is to be best fed. And perhaps, the same method should be used with corn. It is the general observation that the fields are all nearly of equal beauty, when the corn begins to peep out of the ground; the appearance is every where the same, or nearly so, be the soil fat or lean. But it is at the approach of harvest, we distinguish the good quality of the soil: I mean, that there is sufficient juice almost every where, to give birth to plants; and that means should be devised for watering, for distributing a better nourishment, in proportion as the stem stands in more need of it; especially about the time that the flowers are about to form or set, in order to produce seed. By this observation, we might perhaps, come to husband the manure, and make greater advantage of it. That monstrous cabbage, whose vast size was matter of astonishment, and under which was found an old shoe, owed in particular this excessive vegetation or growth to the juices it continued pumping to the last; while the common manures, being of

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service almost only at the beginning, supply nothing farther, when vegetables stand most in need of nourishment.

157. Aquatic plants seem never to require any manure, they are always fresh and vigorous. As we have amphibious animals, so likewise we have plants, which live and thrive equally well on land as in water. Who can tell but we might extend this property to the whole vegetable kingdom? certainly, could but once our corn be made accustomed to water, like rice; could our trees thrive indiscriminately in a moist or marshy soil, like the fallow, the poplar, &c. what considerable advantages might we not derive from fields under water, from lakes, from rivers, and from the sea.

158. One of the best magazines for manure, which farmers can have, is water: wherever it lodges, it deposits a sediment, the goodness of which varies in proportion to the quality of the water, and the time it has stood still or stagnated. Every thing gains in that element a softness, a kind of maceration; and bodies in such a state may easily unite with the earth, which by its means comes to be lighter. Nor is it only those foreign substances, fallen into water, which change their substance, and that vast number of insects which arise and breed in multitudes in it; but besides, it is the bottom, which, in process of time, becomes highly fit to meliorate the land.

C H A P. XVI.

Of the Wonders ascribed to Plants.

159. **I**N times of ignorance, and in barbarous countries, extraordinary effects have been always ascribed to certain plants. A sound philosophy rejects most of these pretended prodigies, or assign them
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a different cause. The nations who were tainted with notions of enchantment, had recourse to certain herbs, in order to produce or counter-act enchantment. But we shall say nothing about these ridiculous superstitions.

160. Several vegetables, it is true, are endued with surprising qualities, which employ the speculations of the learned. The sensitive plant, and some other simples, have a kind of motion, which merits examination. Some kinds of rotten wood give light in the dark, and form a natural phosphorus, from which we might derive great advantages for the occasions of life. There are some zoophyte plants, which seem to partake of the animal kind; others which kill by their scent all the animals within their reach: others again which kill all the plants that lie under their shade. Some cause madness; and others, blindness. In a word, their virtues, good or bad, are so extensive, so numerous, and so extraordinary, that I cannot help insisting on the necessity there is of having a complete history of plants. The pile of grass the most despicable, teems with wonders, not only with regard to its structure, its organization, its life, &c. but with respect to the effects it actually produces, or may produce. The relations of travellers may, perhaps, impose upon us, on the head of the marvellous, which is invented with so much pleasure, and so readily credited by the people; but we are not to condemn all we cannot at first readily comprehend, as is the ordinary custom of the learned. Besides, there are some phenomena, which happen only by the concurrence of several circumstances; and it would be very wrong to conclude, that because this or the other wonder did not happen during the travellers time, it never happened at all. If the *bouras* emits no fire, we must ascend to the source, and discover for what reason this property was ascribed to it: the foundation of popular reports, and their origin may lead us to other discoveries. Who would presume to set bounds to the virtues

of bodies, or to the powers of nature? when we see a piece of coarse metal, hard, and heavy, to keep constantly in motion without any visible cause, and communicate that wonderful property to another metal, merely by touching it. Philosophic pride ought to be on its guard against itself, and suspect its own negative decisions. The attraction, the direction, the inclination, the communication of the load-stone are all so many prodigies really existing. Happy the future age which shall discover all those, of which we are now ignorant, and with which we are all surrounded. These are precisely the enquiries which I propose, and which I wish to see carried into execution for the benefit of mankind.

C H A P. XVII.

Of Animals.

161. **W**E are still in the infancy of knowledge; and even the little which we think we know, we know but very imperfectly: but what we least of all know, is the veterinarian art, or medical treatment of cattle. Scarce a day but epidemic disorders carry off the cattle of a whole province; while the learned of the country are prodigiously taken up with some phenomena in electricity, or with the inscription on a stone of Nostradamus's tomb. Physicians disdain to debase the dignity of their degree, for the relief of other animals, which have not the honour of being endued with the gifts
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of reason or wit; they give them up to the rage of a malady, which would, perhaps, yield to very simple and very common remedies, if they only took the trouble of trying them. Surgeons, in their turn, would think it equally derogatory to their importance, to assist at the dissection of any of these animals. It is doubtless much better all the cattle of a kingdom, both great and small, should perish, than thus to commit or expose the dignity of the medical profession. Let the four-footed race perish a thousand times over, rather than vilify the pompous title of doctor. It is thus a graduate should sacrifice to rank, to name, to the prerogatives of the faculty, the cattle of a whole country: it is thus they give up to a set of ignorant people the life of so many animals, to which we owe the greatest part of our subsistence.

162. They say, that in times past, men made some account of the services and utility of animals, and that society, so much indebted to them, were particularly taken up with the means of their conservation, of the cure of their disorders, of procuring the nourishment the most adapted to them, of increasing them, and aiding their multiplication. They looked upon this branch as a source of real and substantial riches. We, their descendants, derive, perhaps, the same advantages from them, but set a less value on the consequences. In fine, it was formerly said, that the veterinarian school flourished: whereas, at present, it is scarce beginning to shew its head again in some small societies; and shall take years to come to the perfection it is capable of. It is to encourage these new schools, and encrease their number; that every good citizen should concur: but in this, as in all human enquiries, little details cannot be enough recommended, nor the experiments too often repeated, nor the particularity of success too often inculcated. It is this particularity, which I cease not to represent as one of the best means of arriving at discoveries. For example, the study of studs

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of horses comprises an infinity of branches; the detail of their maladies, and of their wants is considerable; but instead of pursuing all these objects at once, let it be proposed, for instance, to cure a broken leg of a horse. This question given out by an academy for the competition of a prize, would produce a much more advantageous effect to society, than so many learned conjectures of antiquaries on the inscription of the broken remains of a pyramid, or on the exergue of a medal of some descendant of the imperial purple. It is possible, that the parts of the broken bone might be easily brought to knit and consolidate again; and possibly nothing but the vast number of the orifices or tubes opposes their re-union; their extreme fineness preventing their re-joining exactly, the solid part of the one filling up the orifice of the other; and in this case a scrupulous attention only is necessary to re-join with exactness these two parts, for the orifices to meet as they should; and perhaps, these two portions of bone should not be pressed one against the other, in order to facilitate the passage of the synovia or other juices. It might, perhaps, be necessary to bind the upper part of the leg to some piece of wood longer than it, to prevent the horse from resting on the lower part, and consequently from dislocating it, during the treatment or cure. Doubtless, the time will come, in which our descendants, making jest of our ignorance, shall be able to cure disorders in horses, for which we now know no remedy. As we shall then be no longer in a condition to blush, we must now inveigh against these distresses, in order to excite the emulation of contemporaries.

163. Nature has set bounds, beyond which all our endeavours cannot pass: from the copulation of two animals of different species, a third arises, which, as all the world knows, is incapable of propagation. This consideration ought not to hinder our looking out, by all manner of mixtures, for new productions, from which we might derive great advantages. For instance, we know the strength
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of the ox, heavy and dull; and the swiftness of the hart, and thus coupling the latter with a heifer, or a bull with a hind, we might possibly procure the most beautiful mule ever seen. The well known species of the jumart, the mixture of the bull and mare, or according to others, of the bull and ass, should invite the curious to search out new mixtures. But, it is not on account of their service or labour only, that animals are of use to us; their wool, their milk, their horns, and their flesh, &c. every part of them is of service to us. How many motives, therefore, have we not to try the many sorts of mixtures, between domestic and wild animals; great and small, terrestrial and amphibious, &c. and then we should come to enrich society with beings of a new species. Their vast number hinders my giving any detail on that infinity of trials, which might be made.

164. We often hear complaints made of scarcity, and the dearth of cattle, without, however, taking any precaution to encrease their number, and of course lessen the price. The consumption continues arbitrary, and the same number nearly slaughtered: an edict might, in a very short time, remedy an evil considerable enough: it is only forbidding, under a severe penalty, the killing any female of what kind soever, for three years only; and we should soon see plenty. Or else, without any prohibitions, or to make allowance for certain cases of exception; as the barrenness of some cows, ewes, and the goats, to permit under a pretty high tax, to sell to the butchers the females, while the males were exempted from it. This distinction will in a short time produce very good effects and the edict will be the milder for it. I make this observation, because, in general, there seems no distinction made, with regard to the sexes of animals, notwithstanding the scarcity there is, and that all are indiscriminately slaughtered. This method is highly absurd; but, especially in countries, in which it is proposed to settle colonies; in those, where cattle is an object of commerce; in those, in which
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pastures abound; in short, I might have said, that this method is absurd any where.

165. We have no business to mention fawns and satyrs, or the manner of their production. These monsters would, perhaps, be of no manner of use to us. The Centaurs were the first men, who were seen a horseback; and, therefore, must go for nothing here. Let us quit antiquity; we have under our eyes phenomena, which offer in the animal kind, and which naturalists should explain to us. Does there, then, exist a generative air distinct from a vegetative? Exotic plants thrive tolerably well in our green-houses, and hot-houses; and above all, they may be reproduced; while foreign animals, monkeys and parrots, for instance, live, it is true, among us; yet kept never so warm, they cannot breed in Europe; nay, not in the southern parts. Whence comes it, that elephants, or at least camels, will not thrive with us? though we have forage to give them, which to all appearance perfectly resembles what they generally use. We can procure them a temperature, equal to that they enjoy in Asia. What good effects might we not derive from all these species of beasts of burthen? as also from dromedaries, panthers, &c. Were our naturalists to study the means of their conservation in our climates?

166. When I recommend to the learned, to dive into, to analyze the parts and properties of the air, relative to the occasions of the respiration of each different species of living beings; I have in particular had in view the peculiar qualities of the air, so different in different places: the juice of the same species of fruit, the grape, for instance, yields an almost infinite variety of wines; each parish, so to speak, has its own wine; and this variety extends from one end of the globe to another; the variety of cheeses made from the same species of cows, fed with the same herbs, is infinite: a distance of two leagues or less still, suffices to render this difference sensible.

sensible. That great number of smells, tastes, colours, and so many changing properties in the productions from the same origin, should be ascribed to some dispositions, some influences of the air! Each country has its horses, its wool, its honey, its wines, its fruit, its game, all different; herbs and all the vegetables differ as much as the animals. It is these qualities which are found in the air, we should endeavour to explain. I mean, that, as all beings differ so much among themselves, and each part is so different from the others; and that as we meet not with two leaves in the largest forest perfectly alike, so, perhaps, not a portion of air, that is not really and essentially different from another.

167. As change of one climate proves hurtful and pernicious to certain animals; another, it is possible, may prove favourable. Tobacco, which was originally brought us from the island of Tobago, proves much better in many other places, where it has been attempted to be sown; particularly in Virginia. The vines taken from the circumjacency of the Rhine, and from Burgundy, make at this day the canary and cape-wines. The bullocks of Hungary and Poland, have improved in Switzerland and in other places. The sheep of Spain, so superior in wool, to all others, are originally from Africa. Our poultry-yards have been stocked with different animals, which have perfectly well thriven. This success should invite to new trials, from which, society would, with gratitude, draw the agreeable and the useful. The rein-deer, so fleet, the delightful antelope, the rhinoceros, the ostrich, &c, would, perhaps, live very well with us.

168. As the veterinarian school, or that for the diseases of animals, should have these diseases particularly in view. The best means of succeeding in the different methods of treating these diseased animals would possibly be, to have recourse to the same medicinal principles, of which the application is made to men. Their disorders

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have doubtless much analogy with ours; only I imagine theirs to be less complicated, and consequently of much more easy cure. Sheep, for example, are subject to the small pox: why, not try on them the method of inoculation? Besides, the advantage of preserving or curing a whole species from a dangerous disorder, we might moreover make a thousand experiments upon them, in order to bring to perfection all manner of incisions, or inoculations, without exposing any individual of our species, to such trials. Sheep are not the only animals subject to this infection. Besides, what a number of other trials might not be made, from the docility of our domestic animals? Their disorders have much affinity with ours, why not combat them with the same weapons, for our benefit as much as for theirs.

169. But, I am, on this occasion, going to relate a fact, to which I was an eye witness; and as it is a cure, from which advantageous consequences may be drawn; those acquainted with the remedy, of which I am to speak, will excuse the pleasure I have in telling it to others. Two cows were taken dangerously ill, a peasant from the neighbourhood, who was considered as a cow-doctor, was sent for; he blooded the two beasts, one under the tongue, and the other in the tail; and ordered both a drench, composed of aromatic herbs, and some other very strong ingredients, such as ginger, pepper, and other spices, with a great deal of salt; this drench was continued for two or three days, worked but a very slight change; the state of the cows becoming dangerous, one of them especially appearing to be very ill, the doctor was again sent for: and then, he opened with an awl or bodkin, the skin, or if you will, the hide of the beast, that was the most sick. This operation he performed on the ribs, at about six inches from the spring of the shoulder; in this opening he thrust a pretty slender slip of some black substance, about ten or twelve lines long; and thrust it in so far, that none of it could be seen;

seen; he again bled in the tail. As he made so great a mystery of this slip, I could not learn what it was: but, then I took care to be exactly informed of the effect of the remedy, which was as follows: the part on which the operation was performed, swelled, and the swelling increased from day to day, till it grew as big as the fist. This species of tumor had a degree of hardness; but, it went off as it came; I mean without suppuration, or discharging any thing but what might be carried off by perspiration. This cow was perfectly cured. The other required the same treatment, which produced an equally good effect. I then, took a good deal of pains to find out what this black slip could be; and I discovered that it was the root of the black hellebore, a plant well known to botanists. The only business is to preserve the different slips of this plant, in a dry place; which I advise owners of horned cattle to do: the same remedy may, perhaps, have the same good effect upon every other kind of animal. I own, I know not the name of the disease, with which these cows were taken, but their case was as follows: they were hide-bound; they refused to eat; their nostrils, their lips were pale, or at least of a bluish cast; their eyes looked muddy or dim, or rather languid. I should have added, that the part where you make the insertion is indifferent; for, in the second cow, the operation was performed in the dewlap, or lower part of the neck; but always in the thick of the skin. In both operations no blood came. Are we to consider it as a cautery, or rather as a blister? might not the same remedy be applied to men? in what cases should it be prescribed?

170. In applying to animals the same medicinal rules and remedies we use for ourselves, I have reason to think, that we should draw a double advantage from it; and that besides the service we should do beasts of all kinds, we should make such trials upon them, as would enrich our pathology and therapeutics. Add to

this, that by combining their physiology with ours, we might fatten the animals intended for our food the sooner and the better; and render those we work, stronger and more beautiful; bring their wool to greater perfection, and increase the quantity and goodness of their milk.

171. There often happens in the country an inconvenience, which how inconsiderable soever it may appear, seems to me to merit the aid of the naturalist; it often takes several hours, and even whole days, to churn the cream, without being able to make any butter come. The poor country maids tease themselves to death, sometimes seeking the warmth, sometimes the cool, and throwing salt into the churn, but all to no purpose: both their labour and their cream are lost. There may possibly be somewhere an infallible method to prevent this accident; and, in that case, it should be made public as much as possible. An academy, preferring the useful to the brilliant, which would propose this question for the prize they distribute, would do a greater service to the public, than by proposing so many frivolous, particular, or futile questions, which we see announced in the public papers.

172. The animals, which we say were created for our use, do not render us all the service we might receive from them; nor is the fault theirs, nor is it the fault of nature, but ours. Their docility makes them submit and accustom themselves to every thing we require of them. And we, ignorant of three fourths of the properties of the beings which surround us, content ourselves with those practices, which we find continued and transmitted to us by ignorance. There is, perhaps, no animal, which has not some advantage, some physical superiority over man; and we have, as it were, their will at disposal; or, at least, we in part direct all their faculties. By education or training, every beast, even the wildest, is reduced to a state of slavery, and made to bend to our caprices, sometimes

sometimes by fear, and sometimes by mere habit. Our natural indolence is a bar to the progress, which we might make in the education and employment of these living beings: but without innovating, let us collect the practices of different nations, and we shall find, that each country will enrich us with some advantage: in some places they eat certain animals of an exquisite relish, which we neglect and throw away; in others, they work certain beasts, which are elsewhere used only for food. We have now scarce any knowledge of the animal, the blood of which strikes the beautiful purple, in such estimation among the ancients. We observe carriages drawn by dogs, by sheep, by rein-deer, &c. it is surprising to see, with what speed these last draw considerable burthens. We derive no use from swine; yet, they are pretty strong, and good swimmers; they might at least be employed, like little dogs, to turn our spits; and one or more of them, put in a large wheel, their weight doubtless might move very large machines. On recollecting the story of the Phrygian, who, suspended a small litter to eagles, in which a young man was carried through the air, we might devise a thousand amazing conceits; which, romantic as they may appear, might perhaps be realized. It would be a pretty sight to see a boat moved by swans or geese; our little country pedlars share with their dogs the weight of their wheel-barrows. But, of all the known animals, there is none, from which we could derive greater service, than from monkeys; it would be only taking them when young, and giving them the necessary training: they would do the part of little slaves. I imagine that the manner of training and forming them for any employment, would require a good deal of care and attention, under proper directions. This art, as all others, would have its principles and rules; and the great advantages, which might be daily reaped from it, would claim the first place after the slave-trade.

173. It would be useless to recount here all the animals, of which we have descriptions in so many relations of travellers; I shall only observe, that with regard to the amphibious, and all the sorts of fish, the crustaceous, and the insects, which live in water, there would be nothing to apprehend from change of heat or climate, See S. 30. The fish which, from the lustre of their colours, we call gold and silver fish, thrive very well in every place, where there is water.

174. There are some species of fish, which live indifferently in salt or in fresh water. Could a naturalist come by degrees to procure this facility to all sea-fish, by throwing certain drugs into the water, or taking them, when very young, out of the sea; could they, in short, be made accustomed to our fresh waters; what pleasure to be able to stock our ponds with the fish of the whole world. I imagine the thing very possible; but not the REVERSE. Nothing more perhaps would be necessary, but to throw at first some bundles of marine plants into our reservoirs. Those fishes to which water is an aliment, and those to which it is only an element, would cause the most essential difference of education. It is surprising, that people do not stock themselves with salmon, as with other species, which, it is well known, can live in the fresh water of ponds.

175. Some persons have begun to stock their ponds with lobsters, and they might, perhaps, as easily do the same for crabs, lampreys, mussels, oysters, &c. Such in particular as live on the coast, might make themselves watry menageries with those numberless kinds of animals to be found in the sea.

176. We find castors in some rivers of Europe, particularly the Lippe. Why are not colonies formed of these animals, to which our manufactures are so much indebted? we might have studs of them, (the name is immaterial), as of so many other wild beasts.

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We have succeeded so well with our pheasantry, that this should put the curious upon making new trials. There is, perhaps, no species of wild beasts, which may not be rendered domestic or tame, by the attentions of education and habit. The fires and dams once becoming such, the whole race would be easily perpetuated on the same footing. Were lions, leopards, tygers, bears, and wolves, formed by nature, only to do mischief?

177. Each country therefore having peculiar productions, has also its peculiar animals. Is it to be imagined, that the same nature has placed them there exclusively? but, if our indolence is a bar to our stocking ourselves with so many foreign animals, why do we not at least adopt the different uses, which other nations employ to so much advantage. In Asia, they make use of pigeons to give quick intelligence to places at a great distance. We have always pigeons, and often as urgent, as interesting news to impart; and we still neglect this useful practice; whereas, we should improve upon, and perfect it. Falconry furnishes an example to be followed in training up so many birds, with which we are on all sides surrounded.

178. The poultry-yard is well entitled to a veterinarian school apart. A society of naturalists, who should only have this branch for the object of their researches, would perhaps find the task too great for them. The art of hatching eggs solicits attention. In Egypt, they employ digesting ovens. Modern authors have given some models; some of which we find in Reaumur, the Abbé Pluche and others; but without the expence of building ovens, and the continual trouble of keeping up a coal or wood fire, which would incessantly require much attention, and above all an exactness, an uniformity, or an essential equality of heat; I imagine a lamp-heat would answer the purpose; we should have only to cover with sand the bottom of a copper basin, or other vessel, to light under it

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one or more lamps according to its extent ; and this vessel to be filled with eggs of all sorts, which should be covered with a piece of cloth or a cushion ; all the business is only to keep up a slight uniform degree of heat ; and the heat of the lamp can neither encrease nor diminish ; we should only need occasionally to recruit the lamp. As we have more particularly in winter, need of this fire, by placing the lamp, it might serve to light the room as usual. By this method, we should come to keep up a degree of heat almost animal or natural, which would always retain its uniformity. If some animals have more or less heat, the difference is not so great, that it can retard the operation I have been just proposing. Besides, we know, that all the dams, even such as sit the most assiduously, quit their eggs every day at different times, to provide for their necessities : this transient cooling should make us conclude , that we should err rather by too much heat, than by the contrary defect. There are so many eggs taken from the nests by the shepherds, an immense loss for the population of the game, that it should seem that this destruction should be provided against.

179. When the egg is hatched, the next care should be the food for the chick, just come to the world. There is, perhaps, no plant, the seed of which may not serve for aliment to the poultry-yard ; we can scarce, except some poisonous plants. And yet we neglect a resource so very considerable ; the poultry, which have the liberty of ranging abroad, and game of all sorts, know how to avail themselves of this liberty. We have already proposed the horse-chestnut, after making a lie of them, and discharging their bitterness ; but I imagine that all sorts of greens may be usefully employed. It is well known, for how many purposes is turnip of late employed, and the facility there is of procuring a great stock of them, in the same manner as of other roots. I mention this, because we cannot exert ourselves too much for means, that shall supersede the use of corn,

to which we always have recourse at a pinch, the scarcity and dearness of which afterwards cause ravages in society, which ought to be foreseen and provided against.

180. Besides the seeds, the roots, and the other parts of vegetables, we should also take into the account the insects of every species. They yield the best food for those young animals, to which nature has denied milk in the first days of their tender infancy. Ant-eggs are already in use; but, we are not to stop there: the same care to provide eggs of silk-worms should engage house-wives to provide tender caterpillars. And thus, that which is in itself a plague, may become highly profitable in the hands of the industrious. It is this œconomical distribution of the several productions, which I consider, as the most useful art to society; the art, which I most earnestly recommend to the researches of mankind.

181. We are not, perhaps, to be ludicrous as some people have affected to be, on the coupling of a hen and a rabbit; we know how imperious and uncontrollable are the orders of nature, when animals are in heat or rut; and might we not take advantage of these moments of effervescence in our poultry, as well as in other animals; and stock our poultry-yards with a variety of moyles or mongrels, the productions of foreign colonies, and of wild fowl with tame. But then, I have no opinion of transfusion, or of the possibility of grafting or inoculating eggs; our trials being never carried so far, we venture not to propose the transplanting the germ of one egg into the yolk of another; and, after having thus exchanged different germs, one against the other, and hermetically sealed their shells, then to set them to hatch. Who knows, but this whim might in able hands produce some curious realities?

182. There are causes of epidemical disorders, which it would highly import us to know. It has sometimes employed attention, but, not in the point of view, which I am going to mention. Some

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years since, there happened a great mortality every where among the pigeons, without any previous indisposition perceivable: not a day passed, without visiting the pigeon-house, in order to remove the dead. Many of them were opened, without being able to discover the cause of the disorder. The year following the dogs were taken ill, their disorder was almost general all over Europe. It was, perhaps, a species of glanders, or running at the nose, from which all the care of the huntsmen could not secure their packs; the year after, rats and mice had their turn of illness, and were found dead at small intervals in the fields. Is it a contagious air, capable of increasing or decreasing its malignity? Is it certain venomous seeds or insects, which destroy, which devour animals? The variety of weather causes rheums, defluxions, pains, &c. in men: it is probable enough, that the beasts may be sensible of other variations in the air, of which, perhaps, we have no perception. It is pretty certain, that, for instance, they often give notice of the approach of rainy or fair weather, at the time we suspect not the slightest alteration in our atmosphere.

183. We laugh at the barbarism of those ages, in which the people ascribed to sorcery the destruction of herds or flocks. And we, equally as ignorant, but much more vain, despise all those pretended enchantments, those influences of the stars, and other illusions, in which ignorance wraps itself up: but, yet the business is not to deny frivolous reasons, though it would be highly to the purpose to assign better. There are certain plants, for instance, to which is ascribed the virtue of intoxicating and infatuating the beasts, which eat of them: it is very possible, that some evil-minded persons, who happened to be acquainted with the hurtful qualities of the numerous productions of nature, might make a bad use of them, on their neighbours cattle. This sorcery, is rather a natural magic, which
might

might be easily discovered, in order to point out the remedy ; but, as the case is very rare at this day, it is needless to dwell upon it.

184. Let us return to cases, which are of a more general nature, such as the changes the atmosphere undergoes, or some vegetative soul, or principle diffused in the air. Scarce a year passes, but the variations are very sensible in some subjects ; and perhaps, there are no fewer in beings, less susceptible of being observed by us ; as, after a plentiful season in fruit, we have almost always one, half barren, and thus successively : and thus, may-bugs, or chaffers, are very numerous one year, and very scarce the following. It is, perhaps, in the diversity of the population of insects, we might come to discover the cause of the diversity of several accidents, and among others, of those epidemic disorders, which sometimes attack one species, and sometimes another, and to which we ourselves are exposed.

185. This present year, 1768, presents, for instance, a pretty singular phenomenon, and which, they say, formerly happened. The country of Juliers is over-run with mice ; they are there in vast numbers, they destroy every thing : the granaries, the gardens, have sustained vast damage. What is pretty extraordinary, is the variety of their colour. Their astonishing multiplication resembles much a scourge, or one of the plagues of Egypt. On enquiring into the cause of this calamity, we may light on the remedy, and above all draw consequences, hitherto unknown, on the inconstant succession of seasons and numerous other phenomena.

186. When we speak of the diseases and death of certain animals, we are always to understand domestic ones, unless in the case of a general epidemy, which seizes all without distinction. This, at first sight, appears highly romantic, or, if you will, ridiculous and absurd ; but let me only ask the oldest and ablest huntsmen, the most rational travellers, the cottagers, who range the fields and woods, ask the naturalists, who make observations, if ever they met

a wild animal, that died a fair or NATURAL DEATH. From the smallest bird up to the largest wolf, let them say, if ever they found the body of any beast, unless it bore the marks of a wound, of poison, or some other bloody accident. Let them tell us, if they ever heard, that any one was assured or convinced of the death of any fallow beast, any game, or any bird of prey, raven, or of whatever other species, that died of old age, of caducity or decay, and died a natural death: I request the naturalists, ever enemies of the marvellous, which they even disdain to hear, to vouchsafe to make enquiries on this subject; but divesting themselves of the prejudice too common to the learned, to believe nothing of that which they cannot explain. I only require a single instance of a body, out of the many species of animals, and let them observe it, when found, and assure themselves, that nothing foreign contributed to its death.

187. It would be dishonourable enough, and highly cruel with respect to mankind, to say, that the beasts feel scarce any other evils, but those we bring upon them: but on a serious enquiry into the truth, we are highly astonished not to be able to assign the term of life of any wild animal. The learned, whom I have just mentioned, will have recourse to the carnivorous animals. But what comes of these last in their turn? what should they do with the bones, feathers, and skins of numerous beasts? how reconcile the vast disproportion between the prey and the preyer? but, let us, for instance, take the hart, the hare, or the partridge, which overspread the fields, where the game-laws are severe; was there ever found a single one dead or dying? and yet, there should be among them young, old, and very old. The peasants are constantly crying out, and complaining, but all in vain; death destroys none of them, it must be the hand of man. The ravens, of which we see such vast numbers in so many places, feed upon or devour other bodies, without our perceiving that a single one fails of their number. Such as
were

were formerly taken, and which some were pleased to distinguish by some mark, as the stag, by collars or rings, were found alive several ages after; but, then, it was necessary to kill them, as it would be impossible to ascertain the time of their death afterwards. What I say of wild animals, I extend to all the known species, fish, fowls, quadrupeds, &c. It is enough that they live at a distance from us; their deaths, and even their disorders will ever remain so many riddles to us.

188. Besides the diseases, which domestic animals contract, it may be said, that almost all the species preserve, while at large, an exact and singular conformity in gait, size, and even in colour. In a thousand sparrows, no one is distinguished from another; each species of swallows retains its invariable distinctions; one snipe perfectly resembles another, &c. But our dogs, our horses, our oxen, and the other domestic animals differ essentially one from another, in shape and colour. Our jockies know how difficult it is to match a set of horses well.

189. But it is not only the age and death of wild animals that is a mystery veiled from our eyes: who is he that is acquainted with their places of retreat in winter; not only of birds of passage, but of three fourths of all the other species, which disappear during the cold? some are for sending the swallows across the seas, like the quails, who go in quest of the warm climates. Others lodge them in the waters, in marshes, or in the holes along some banks. But what becomes, in cold weather, of all those birds, with which, in the warm season, our fields, woods, and gardens swarm? it is proper to observe, that those birds which had disappeared, shew themselves again, in the beginning of spring, all over Europe, almost on the same days. This observation was made, at the command of a certain prince, by the huntsmen of different countries.

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190. We know several species of animals, which pass the winter in a profound sleep; we might extend the same conjecture to the other families, the lot of which we are ignorant of. All the insects disappear. But what comes of them? is the entire race preserved in the eggs laid by butterflies, which no longer exist? in that case, the whole of this tribe would be every year entirely destroyed; and every year, now a nymphe or chrysalis, again a caterpillar and butterfly. In all these metamorphoses, these animals would have an existence of a few days only. As to the sleep of badgers, marmosets, rats, and other species; is it possible to procure the like sleep to other animals? the peasants at a loss for food to their cattle, during the winter, would in this have a very commodious expedient. Could man himself live long in this state? Epimenides, then, the seven sleepers, and other tales, would no longer be fabulous.

191. Ants and bees neither die nor perhaps sleep during the winter; at least their stock of provision would be useless during their sleep. It is therefore in those countries, in which a perpetual summer reigns, that observations should be made, to be compared with ours. It is thus we should come to draw the veil a little aside, with which nature covers herself, and to discover new prodigies. One day, perhaps, we shall have new wonders to admire, and the learned new explications to give. The pretended stock of provision of the ants is, however, contested, and we are told that other animals lay also up. Man, who thinks every thing allowed him, would, doubtless seize on these magazines, or hoards, if the animals who make them, had not the cunning to hide them.

192. It is not only the useful, which animals procure us, but besides, the agreeable: they amuse us in so many different ways, not to be recounted but in a larger work, and which I forbear here. That faculty, which we more particularly employ for our pleasure, is their memory, their aptness to imitate is very amusing. As the
monkey

monkey by his actions, the parrot by his voice, in the same manner as magpies, jackdaws, and several other birds, which repeat the sounds that have often struck their ears. It is well known, to what pitch parrots imitate the human voice. The canary bird comes to pronounce words distinctly, and sing several airs; it is highly pleasing, when he is brought to learn the song of the nightingale; the business would be to provide a new one, when the first has finished his time of warbling. We might, perhaps, apply this method to several other animals, in which we suspect no such disposition. In this, trials and patience are necessary.

193. Who knows, but the fable of the jay, who plumed himself with the peacock's feathers, might be put in practice? the young plumes of one bird, transplanted in the room of those, that were pulled, would take root, as well as the teeth of a young Savoyard in the jaws of a duke or peer. But why should we torture these little innocent creatures, to procure a pastime, which must soon have an end, I mean at their time of moulting? we might, however, try to prevent the fall of the adventitious plumes, by burning their extremities. When we want to keep at home wild birds, there is no other secret, but burning the wings, which never shoot more. It is by this so easy a method, we might form a yard of partridges, bartavelles, or large red partridges, wood-hens, wild ducks, and every other kind of game.

194. We take a great deal of pains to make the birds, I mentioned in section 191, utter a few words; and, after all, it is but a cold repetition, which can have no other use, but the pleasure we take in it. Could we instruct these animals so far, as to enable them to give some meaning to the words they pronounce, it would, perhaps, be a very considerable thing. But, since, to this day we have not been able to proceed so far, the narrow ideas of animals having bounds, which we cannot recoil, why not endeavour to understand
their

their language? they, doubtless, speak, their sounds are modified, varied, and express perfectly well what they feel. An huntsman shall distinguish perfectly, when his dog is fighting with another, when courting, when in pursuit of his game, or when confined or tied up. All his wants, and, if you will, all his ideas, have their own particular sounds. What I say of dogs, animals we are more familiar with, may be understood of all animals. The diversity of their cry is very well understood by all of the same species. But I imagine that, how dextrous soever we might be at this knowledge, we should learn little from them but the alterations of the weather, which they foresee far better than we. And besides, this is no longer the age of Apollonius Tyaneus.

195. It seems very strange, that we cannot get rid of noxious animals. The English, for instance, have extirpated the wolves from their island. And notwithstanding all the forests in the north, the unanimous consent of the neighbouring countries should procure for one part at least of Europe the same advantage. But when we recollect the wild beast of the Gevaudan, which kept so long one or more provinces in constant alarm; and when we reflect on the troops and huntsmen, who carried on an unsuccessful war against it (at last killed by accident) we are no longer to be surprised at the plenty of wolves. Besides all the species of carnivorous animals, with which we are overrun, what number of birds of prey have we not? it is for these evils we should seek out a remedy. The discovery of an infallible method of securing ourselves against the inroads of rats and mice would be infinitely more useful than the sum total of all the questions, proposed by some societies, since their first establishment. It is not only quadrupeds, as polecats, foxes, weazels, and a hundred other like animals, that persecute us to our very doors, we sustain the brunt of a thousand insects, which make inroads on our very persons. I have seen a
charming

charming grove, in which there was no walking, for swarms of gnats, that pestered you, and obliged you to retire. Pitiful philosophers! while you range the heavens, the mice are ranging your granaries; and while ye are building a vast and sublime system on the general movement of the universe, the moths are laying waste your wardrobes. Pay some attention to the wants of society. There are many poisons for some beasts, which are harmless for others: run over the productions of nature; animals, perhaps, have an antipathy for some things; the business is to discover them and make them public. This is what we ought to expect from the care and attention of naturalists and philosophers. Besides those visible insects, we have possibly a still greater number of invisible enemies. A certain physician ascribed all our maladies to the presence of a different animal, which had settled a colony in our humours, or our blood. This we are not to take literally. From this, however, we may see, what researches still remain to be made.

196. There are several kinds of animals, which ordinarily produce only one young at a time; but extraordinarily however, two or three. This double or triple production is, doubtless, very interesting; we should dive into all the means to procure it. A thing, perhaps, as easy, as varying the colour of their skin, by putting little pieces of wood in the bottom of their watering-places, as Moses shews. Some more heating liquors or richer, some herbs, such as are used to make the females desire the male; or, in fine, some other regimen might answer that end. This matter merits the nicest observation: as to those beasts, that drop several young at once, it would be highly proper to know every thing, which may concur to increase or lessen their fruitfulness. What riches might not be multiplied by this means? I believe, indeed, we might lose something in quality, but gain a great deal in quantity. We are not to be disquieted about a more abundant nourishment, which a

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more abundant family would require: it is a thing long known in the country, how to supply the defect of dams: there is only requisite a little more attention at first: this is a matter for thought and deliberation, and to be proposed for a prize.

C H A P. XVIII.

Of the Productions of some Animals.

197. **W**E make use only of the milk of some certain animals: whence comes it, that we neglect that of many other species? that of mares, for instance, is carefully collected by some people. As the eggs of all birds, so the milk of all quadrupeds, would, doubtless, be a very wholesome food; at least it is the only kind of food which nature seems to have especially allotted us. We might possibly find in different sorts different qualities; in that view it is, that medicine prescribes asses or goat's milk. Who knows the virtues in that of a bitch-dog, a sow, a wild sow, a hind, &c. While many poor families are starving and in misery, what variety of succours might they not derive from such different milks that are totally neglected? the cheese of mare's milk may, for aught I know, be delicious; at least, we should eat it with less reluctance than spiders, which are said to have an exquisite taste. This leads me to think, that perhaps there is not any one beast, which may not serve us for aliment. It is

is well known, that the flesh of vipers is not only a palatable food, but a valuable remedy. If, therefore, so venomous a beast may be safely eaten, may we not conclude, that there is none, of which we might not avail ourselves?

198. We are still far from being acquainted with all the uses to which the milk we daily use, may be put. In Iceland, where they have neither salt or vinegar, they make a vinegar of milk, in which they preserve their fish and their flesh for a very long time. We should procure the knowledge of the means, which they use, to bring their milk to that pitch of fermentation; we might possibly perfect the method, which they follow by a mere practice of rote. It is thus we might come to distill the spirit of this new vinegar; and, after having perfectly well concentrated this spirit, we might procure an animal acid, upon, and with which we might make several grand trials. I must, therefore, invite our naturalists, and above all, our chymists, to urge, or rack by fire, this animal spirit in every possible way. The result, may, perhaps, be attended with very important consequences, both for physiology and chymistry.

199. Honey was formerly in great use; but, since sugar is become so common, we have quitted our native production for that of America. I imagine, that medicine is in this a considerable loser; and that the virtue of an extract, made from the most valuable particles of a thousand different flowers, cannot but have the advantage over the juice of a cane. Besides, sugar is become almost a commodity of the first necessity, so as to reduce all Europe to a state of dependence on the new world. It is on all these accounts, that I propose the extracting the salt or sugar of honey; I imagine, we might give it the whiteness of the finest sugar. We see that wax, which is nearly of the same colour, is brought to rival snow in whiteness. There are, besides, certain districts, where the honey is naturally of the finest white. If, therefore, we could come to crys-

lize the falt of honey, it might, possibly, gain a more agreeable taste than is that of the American sugar. An object this of policy, of health, of reason, and œconomy, merits, doubtless, the application and attention of the naturalist: happy the man, who shall enrich his country with this discovery. The art of refining honey, improving its flavour, and forming it into fine crystals, cannot fail to immortalize the name of the inventor.

200. Besides all the plants, the essential or fixed falt of which may supply the place of ordinary sugar; there is also a sugar drawn from milk, which is said to be an excellent remedy in the gout. Nothing more seems wanting, perhaps, but to abridge the operation, to render this discovery of the utmost service to mankind.

201. Wax, too, is a thing in great demand; it constitutes a branch of commerce, which should draw the notice of the naturalists. Might not the method of bleaching it, now left to common work-men, who have only a rote practice, be improved and abridged? Who knows, but it might be rendered transparent; combined with several other more common materials, without impairing its beauty, we might, perhaps, communicate to it a degree of hardness, which would fit it for a thousand new uses; for if, certain mixtures could, by hardening it, preserve it from the action of heat or fire, statues might be formed of it, which should imitate marble, ivory, or other bodies. In short, we might employ it in a thousand works, susceptible, as it is, of all the figures, and all the colours we chuse to give it. Wax has, besides, another more singular property. I have read in some old book, that a very thin vessel made of wax, will only admit pure water, and strain it, without allowing heterogeneous particles, falt, for instance, to pass with it through the pores of the vessel. If this is true, we might easily procure fresh water, at sea, by means of these vessels artfully contrived. It might possibly be requisite to add a mixture of ashes or other porous substance.

202. Amidst

202. Amidst the different productions of insects, we ought not to omit colours. Father Plumier, a celebrated botanist, speaking of the cochineal, says, that a crushed spider, fallen accidentally into a glass of water, tinged it of a blue colour*. He likewise tells us of a tansy plant (*tanacetum vulgare*) being found covered with a great number of insects, which yielded a red, as deep as blood; and adds, that we might procure a green, which painters are so much in want of, by making trials on insects. But how many other properties have they not, which remain to be still discovered? Medicine, in particular, would have here a fine field to reap.

* Mem. de Trevoux, Sept. 1703.

P O S T S C R I P T.

203. **I**T is usual with authors to make compliments to their readers, before they enter into conversation with them; but, I find not, that they use the same politeness, when they quit them.

There would, perhaps, be as much policy to interest the judge, the moment he is about to pass sentence, as to prepossess him at the beginning of the process.

Though, I have none of these motives in view, I omit not here to entertain myself a little longer with the public; because, I have really something to tell them. I have a good stock of notions to offer; I have made a collection on natural philosophy, which I shall have a good deal of difficulty, to bring down to the level of every capacity; on politics, a subject, perhaps, too dangerous to be treated

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ed on; on morality; for when the judgment is no longer stifled by prejudice, it ranges every where, and its flight soars far beyond the clouds.

I have, also, some thoughts on tactics, especially naval; but, a philosopher should not meddle with so cruel an occupation.

I have, likewise, on optics, and on many other different objects, which have not any mutual relation. But, as I cannot tell, whether among these rhapsodies any shall take, I shall not venture to publish any more; unless, I have reason to think, that these I now publish, have made some impression: I mean, that, if the public reaps no benefit from the PROJECTS I lay before it, I shall stop short here.



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